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The Pneumothorax Treatment of Pulmonary Tuberculosis

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In presenting this article I feel that the treatment of pulmonary tuberculosis by artificial pneumothorax, which has achieved many a brilliant cure in the West, has not received its due share of attention at the hands of the medical men of my country. Hence I have attempted, to the best of my abilities, in the following pages, to take stock of the knowledge that is now available on the subject, and to assess the value of this mode of treatment in pulmonary tuberculosis.

HISTORICAL SURVEY.[1]

A close review of the literature on phthisiotherapy reveals that over a century ago artificial pneumothorax was recommended as a method of treatment in pulmonary tuberculosis with a view to stop the elastic expansion and recession of the diseased lung during respiratory movements and thus to ensure absolute rest of the diseased areas until healing took place by resolution, or by fibrosis and calcification. In 1821, JAMES CARSON of Liverpool urged its trial in the treatment of pulmonary tuberculosis and proved its practicability by animal experiments. JAMES HOUGHTON in 1832 and STOKES in 1837 reported clinical improvement in some advanced cases of phthisis as a result of spontaneous pneumothorax. Though the foundation stone of pneumothorax treatment was thus laid at first on a theoretical basis and later on animal experiments and clinical reports, it was not until 1888 that FORLANINI, the Italian physician, gave the first practical demonstration of treating pulmonary tuberculosis cases by artificial pneumothorax. He was followed by SAUGMANN of Copenhagen who in 1904 made a practical contribution to this mode of treatment by discovering the water manometer. By 1906 FORLANINI reported 25 cases of pulmonary tuberculosis successfully treated by artificial pneumothorax.* Meanwhile the phthisiologists of other countries adopted this treatment in quick succession. In 1905-1906 BRAUER, of Hamburg, reported his first series of cases treated by A. P. In 1908 DUMAREST began this treatment in France and in 1910 KUSS advanced it further. In 1911-1912 HARRIS and ROBINSON introduced it in America. In 1911 LILLINGSTON and PEARSON introduced it in England.

"As a result of the trial this treatment has had during the last quarter of a century" writes a French writer, "experienced physicians all over the world assign to it an eminent therapeutic value. Such an equal unanimity in the appreciation of any other anti-tuberculous remedy has not been seen up till now." According to another distinguished physician, all other modes of treatment and remedies that have been recommended during the past three to four decades for the relief and cure of pulmonary tuberculosis, have been stated to exercise their curative effects only during the incipient stage of the disease, when

* Henceforth the abbreviation A. P. will be used for Artificial Pneumothorax.

diagnosis is doubtful in a large number of cases and spontaneous cure is not unknown. But this newest method of treatment has been applied with striking success in far advanced cases, where other methods for checking the progress of the disease have failed.

It is not too much to say in the words of DUMAREST, the French phthisiologist, "In phthisiology the A. P. treatment is the greatest discovery achieved since the institution of the hygienic cure by BREHMER." In fact, the aphorism formulated by FORLANINI himself "Le pneumothorax guerit la phthisie" or better "Le pneumothorax peut guerir la phthisie" is beyond doubt.[2]

RATIONALE OF THE A. P. TREATMENT.

From the historical survey, I shall now pass on to discuss about the rationale of the A. P. treatment : how it promotes healing of the disease process. I like to emphasise at the very outset that the effects of A. P. on the disease process will largely depend on the degree of resulting lung collapse. Experience has shown that the better the lung collapses, the better are the effects of A. P.

The effects of A. P. on the evolution of the pathological process and on the organism as a whole may be classified [3] as follows :

1. Mechanical Effects :
   (*a*) Promotion of the natural tendency of lung contraction and the collapse of thin-walled recent cavities.
   (*b*) Arrest of the extension of small or large cavities, facilitation of expectoration of bronchogenic and lymphogenic dissemination.
2. Physiological Effects :
   (*a*) Reduction of blood flow through the collapsed lung and consequent interference with the passage of toxins into the general circulation.
   (*b*) Diminution of lymph circulation leading to lymph-stasis.

The above factors favour the demarcation of the diseased areas and new formation of connective tissue.

3. Immunological Effects :

COURMONT, CARPI and others[4] have shown that under A. P. treatment there is some evidence of increase in the opsonic index and the agglutinating power of the serum.

PRACTICAL CONSIDERATIONS ON SELECTION OF CASES :

The success of the A. P. treatment depends, however, on a proper selection of cases. The ideal case for pneumothorax treatment is, of course, a unilateral case both in the clinical and radiological sense. But in any large series of unselected cases, both in hospital and private practice, the percentage of suitable cases have been very small (3·5-10%) in the series of different observers :[5]

Name of Author.	No. of unselected cases.	Percentage suitable for A. P.
FISHBERG	210	10
BERNARD	621	3·5
COURMONT	352	9
FERRIO	700	6

But it must be realised that these figures of suitability for A. P. treatment cannot represent the true state of affairs. The percentage of suitable cases will increase to a considerable extent if every physician would take care not to let the suitable stage slip away.

It is, therefore, essential that one should have a thorough knowledge of the types of cases that are suitable for the A. P. treatment and those that are not.

SUITABLE TYPES.

A. Cases with unilateral lesions :

I. Early Exudative Sub-apical type.

This type is usually met with in young persons (60% occurring below 25 years of age). The onset is relatively abrupt with an acute febrile illness, often wrongly diagnosed as "Influenza" or with cough or haemoptysis or with both. The physical signs are often absent. The only constant physical sign that may be present is moderately coarse crepitations in the 2nd or 3rd interspace or the upper part of the axilla. A good radiogram shows in such cases the "Fruh infiltrat" of ASSMANN and REDEKER—a soft cloudy patch

clean cut or ill-defined in the 2nd or 3rd interspace towards the periphery or in the mid-zone or even rarely in the lower zone (Vide Plate III).

Plate III is the skiagram of a woman aet. 18 years. Onset with cough and later haemoptysis in streaks for 3 days before admission to the hospital, fever upto 99°F. Sputum was found negative to tubercle bacilli on two successive examinations in course of a week. This case was considered an ideal case for A. P. treatment which was accordingly induced but she left the hospital a few days later against our advice.

This early patch of infiltration is broncho-pneumonic. As RIST [6] points out "this lesion may exend rapidly involving the whole of a lung lobe in a few days, even in a few hours after the onsent. It is generally partly absorbed leaving behind ordinary evolutive lesions of tuberculosis. By X-ray it has been seen that a greater or smaller part of this broncho-pneumonic patch may ulcerate into a cavity without passing through the intermediary stage of caseation in the course of a few days or even in a few hours."

Such cavities are called by the German workers "Fruh caverns". (Vide Plate IV).

This is the skiagram of a young man aet. 25 years. Onset with cough followed by haemoptysis in streaks on two occasions and subsequent fever of 101°-102° F in the course of the month before admission. Sputum showed numerous tubercle bacilli at the first examination. On physical examination, dulness on percussion and bronchial breathing were detected over the right lower lobe behind. This was also deemed a suitable case for A. P. treatment. Plate V and Plate VI show the condition of the right lung after A. P. This patient is still having refills at intervals of 2-3 weeks. His temperature has come down to normal range. His weight is stationary. But, as is usual in these cases of juxta-hilar caverns, sputum is still positive to tubercle bacilli, though, in few numbers. He has been under treatment for nearly a month and a half. In this connection, I may mention that the occurrence of a "Fruh cavern" in the juxta-hilar region of a lower lobe is a very unusual thing and I, at any rate, have not come across more thar half a dozen instances of such a type of disease in foreign literature.

It is true that such early acute phases of the disease may alternatively be treated with success under the conservative regime of prolonged rest cure in sanatoria at high altitudes, supplemented with or without the use of gold salts in the pre-cavernous stage, but from the economic considerations, which play such an important role in India, I would urge A. P. treatment as a necessity in case of adults who have not the means to undergo such prolonged natural cure in sanatoria and who have to return to their work in a comparatively short time. The arguments that are advanced from some quarters against the treatment by A. P. of the early infiltrative phases of the disease, are :

(1) Development of pleural effusion in 30 to 50% of cases in the course of A. P. treatment leading to failure of lung expansion and conversion of the early exudative disease into the chronic fibrocaseous type by the supervention of pleural symphysis.

(2) A slightly greater frequency of pleural shock both during the induction of A. P. and during subsequent refills (DE CARLE, WOODCOCK and CLARK.[7])

(3) Cure of the disease under the conservative regime is possible.

But these arguments are not convincing. In the first place, it should be realised that the chance of development of pleural effusion is much smaller in early cases unaccompanied by gross cavernous changes. Secondly, even if pleural effusion develops in some cases, pleural symphysis can be prevented under proper radiological control by repeated replacement of fluid by gas or oil (oleothorax) if necessary.

Thirdly, if the disease is treated in its early phases by A. P., the duration of treatment is less than 2 years and the chance of failure of expansion on the part of the collapsed lung is minimal. Fourthly, the postponement of A. P. to a later date does not seem to be justified for two reasons :

(*i*) The more ancient the tuberculous lesion is, the greater is the liability to formation of pleural symphysis which will render the future A. P. treatment difficult, impracticable and unsuccessful.

(*ii*) Also there is a greater chance of bilateralisation of the disease in future. I shall speak about this in details in the latter part of my paper.

At the Trudeau Sanatorium, Lake Saranac, a modified procedure is adopted in regard to the treatment of the disease in the early phases.

All cases with or without cavities are treated with rest and general hygienic measures. They are radiographed every 6 weeks and if, from a study of the serial radiograms no arrest of the diseased process is seen in 3 months, A. P. treatment is started. 25% of "Fruh caverns" have been observed to disappear under enforced rest.

Such preliminary observations, for 3 months, controlled by serial radiograms in order to study the activity of the lesions, should form an essential condition in most cases before A. P. is instituted. I would add further as essentials that—

1. The radiograms must be taken every time at the same anti-kathode-film distance preferably 2 metres with the same kilovoltage and milliamperage (100 K. V. and 60 milliamperes) under the shortest time-exposure ($\frac{1}{10}$—$\frac{3}{10}$ sec.). Of course, the kilovoltage might have to be altered in certain cases according to the body-weight.

2. The sedimentation rate of the erythrocytes (WESTERGREN method) should be recorded every 6 weeks. An increase of the rate of sedimentation above 10 mm. at the end of one hour or above 20 mm. at the end of two hours indicates an active lesion.

3. Last but not least, the clinical findings regarding temperature, pulse, weight and appetite should be thoroughly taken into consideration.

Thus, if all these observations unmistakably indicate the progressive nature of the lesion, A. P. treatment should be adopted without delay.

II. Fibrocavernous lesions of one lung only : (Plate VII). This is the skiagram of a man aet. 35 years. Onset with haemoptysis and later fever 98—102 F, for 8 months before admission. Physical signs :—Left upper lobe showed crepitations and weak breath sounds only. Few crepitations were heard over back of the right lung. Sputum showed tubercle bacilli. Both liver and spleen were moderately enlarged.

The lesion in this case, though unilateral, is fairly advanced. The cavern is a gross one. Such cases are likely to derive special benefit from A. P. treatment because the cavities are emptied and their walls, unless held up by strong adhesions to the chest wall, can be approximated by collapse of the lung. An A. P. was performed on the left side resulting in good collapse of the lung confirmed by flouroscopic observation but the patient left hospital a week later against our advice and has not been heard of since.

III. Unilateral fibro-caseous lesion : (Plate VIII). This is the skiagram of a man aet 42 years. Onset with haemoptysis of about 8 ozs. of blood during one whole day about 4 weeks ago from the date of admission. Fever 100—103 F and cough with scanty expectoration followed the haemoptysis. Loss of 8 lbs. in weight in one year. Physical Examination showed : Dulness on percussion over whole of the right lung behind but on upper lobe in front ; moderately coarse crepitations over the same areas. The band of apical resonance on the right side was contracted to 2·5 cm. as compared with 5 cm. on the left. The movement of diaphragm on the right side was very small—½-1 cm. as compared with 3 cm. on the left side. The left lung showed signs of compensatory emphysema. Sputum was positive to tubercle bacilli.

This was considered to be an ideal case for A. P. treatment from theoretical stand-point but unfortunately, A. P. could not be induced because of the presence of pleural symphysis.

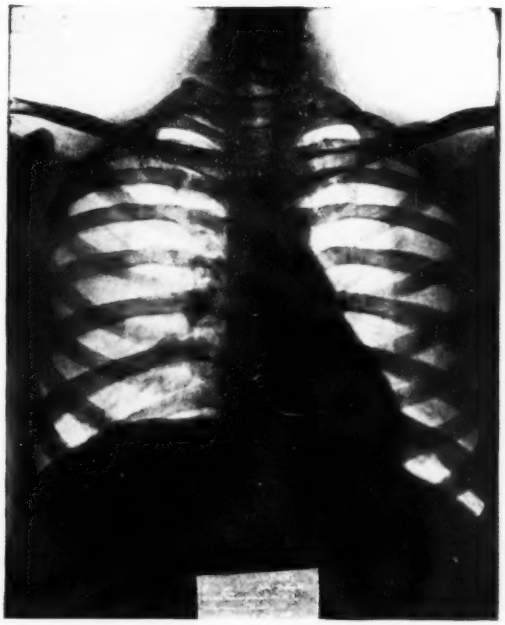

Plate I.

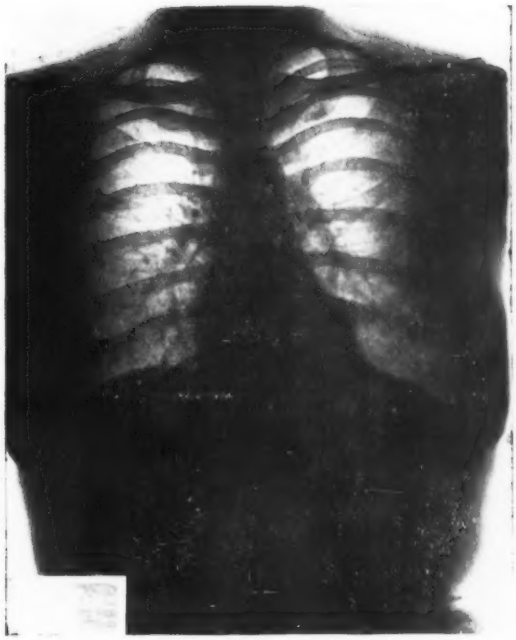

Plate II.

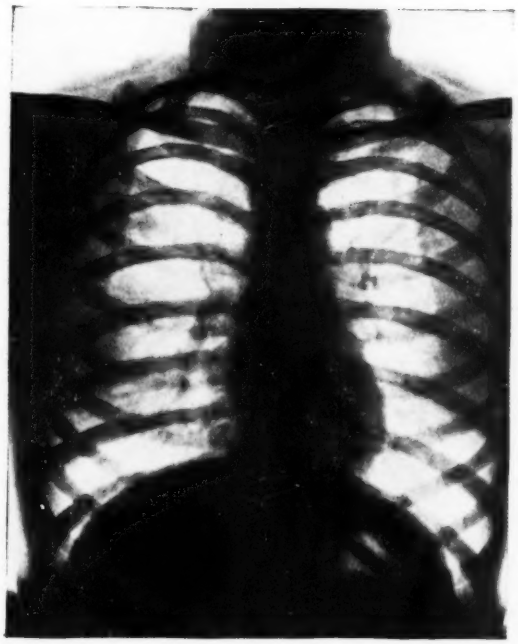

Plate III.

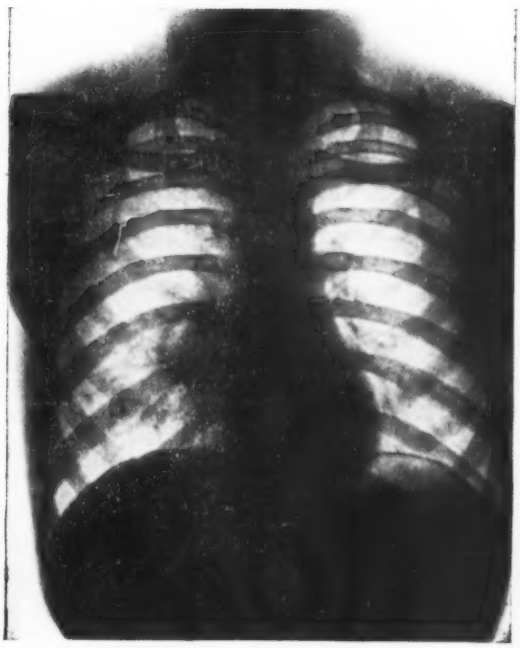

Plate IV.

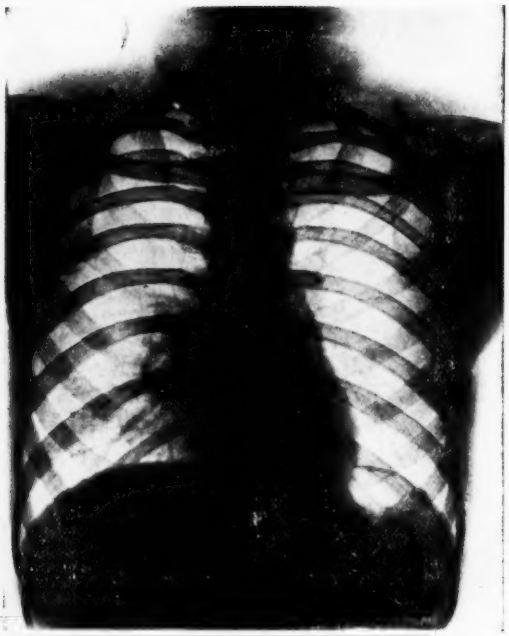

Plate V.

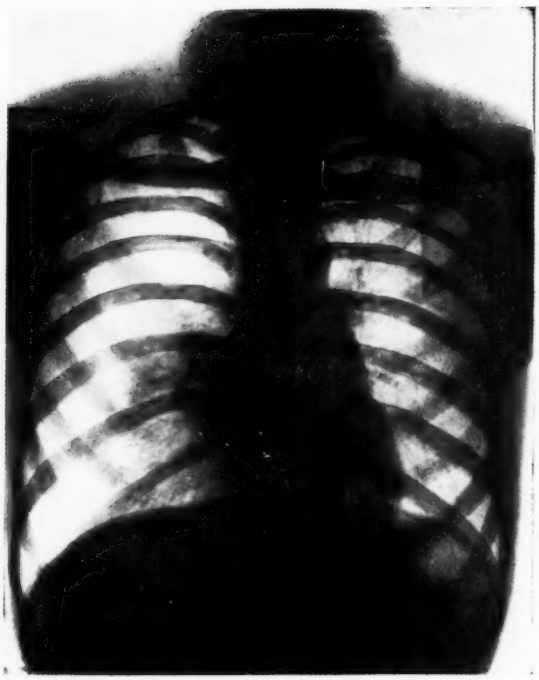

Plate VI.

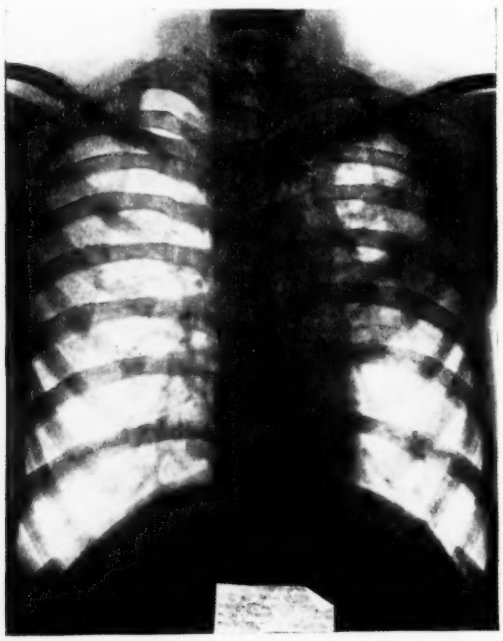

Plate VII.

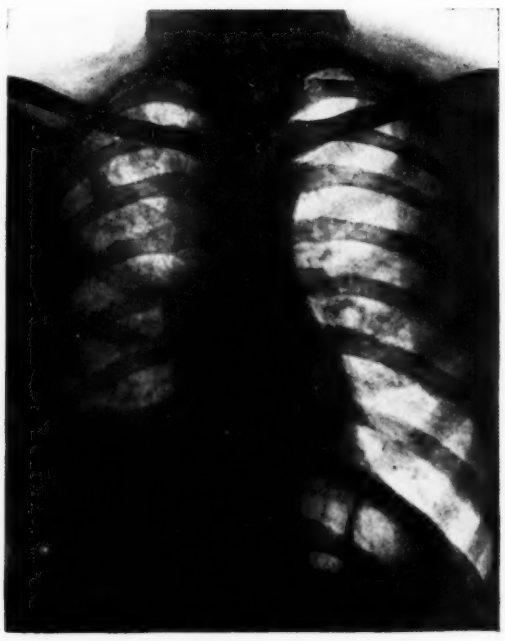

Plate VIII.

By the way, I might mention that I performed later the operation of phrenic avulsion on this case and he is doing very well until now. The details of this case will be published later.

IV. Unilateral cases of Caseous Pneumonia or bronchopneumonia (Lobite).

In these cases one or more lobes of a lung is consolidated and radiologically shows a homogeneous diffuse opacity demarcated by a linear or arched shadow of the interlobar septum.

R. A. YOUNG [8] deprecates A. P. treatment in this group of cases, unless, on strict rest, there is some evidence of a protective reaction. The MATSONS[9] state that inspite of statement to the contrary, satisfactory collapse may be obtained and splendid results have been seen.

BRAUER, SAUGMANN and DUMAREST, [10] all advocate A. P. treatment in such cases and report success in 25%.

The only possible danger in such cases during A. P. treatment is development of pleural effusion. It would not be quite out of place to mention that one such case of caseous pneumonia of left upper lobe in a woman aet. 29 years was seen by me, at the Brompton Chest Hospital, cured after A. P. treatment of 4 years under the care of my chief DR. BATTY SHAW. The healing occurred in this case, as in other reported cases, by fibrosis of the left lung with the heart and mediastinum displaced to the left.

B. Bilateral lesions.

I like to stress at the very beginning that bilateral involvement of the lungs does not necessarily contraindicate the A. P. treatment. By far, a large number of cases that turn up in practice are bilaterally affected.

In such cases, each case should be judged on its own merits and A. P. should be induced as soon as possible on the most affected side.

Under such treatment, limited active lesions of the opposite lung have been found to improve (FORLANINI) and good results have been obtained where the disease in the opposite lung was confined to the apex, the upper lobe or hilum (CARPI, MATSONS, and GRAVESEN).

Favourable types :

I. Cases, with more or less widespread lesions of one lung, accompanied by contralateral lesions limited to the upper zone are, from the practical point of view, quite favourable (Plate IX).

In this case, A. P. should be induced on the left side and the collapse is to be continued for 2-3 years. It is most likely that the early subapical infiltration (almost invisible on the positive print) will undergo complete resolution in 6 months.

II. Plate X shows another case of a favourable type of bilateral lesion. Here, A. P. may be recommended on the left side to start with and it is quite probable that the left lung will show a good collapse.

III. Plate XI is the skiagram of a man aet. 30 years. Onset with intermittent fever for 8 months, accompanied by cough and expectoration, pain over the upper part of right chest and haemoptysis in streaks for 4 months. Physical examination revealed the presence of a cavern in right upper lobe with crepitations over the whole of right lung, left lung showed no abnormality except slight dulness at left base behind and weak breath sound over the same area. Sputum was positive to tubercle bacilli.

In spite of the diffuse infiltrations over the left lung parenchyma, A. P. was decided upon. Plate XII shows the results of A. P. about 3 weeks later and sputum showed no tubercle bacilli on three consecutive examinations. But, unfortunately, as was expected, the good results did not persist because of the failure of collapse on the part of the upper portion of the lung tissue containing one large and two small cavities.

Inspite of the refills, sputum is now positive and the patient is getting sudden rises of temperature to 101°-102° F., gradually returning to normal in 1-3 days, at each refill.

In such cases, the full effects of collapsotherapie can be obtained only when these adhesions are first coagulated by diathermy current and later cut through by diathermy knife through a thoracoscope (MAURER) [12].

IV. Plate XIII is the skiagram of a man aet. 30 years. Onset with fever, cough and expectoration for 11 months before admission. On admission, he was found to have 4 diarrhoeic stools a day, marked anaemia. Physical Examination showed dulness on percussion over nearly the whole of right lung, signs of a small cavern in right upper lobe and contraction of the right apical band of resonance, and dulness with crepitations over left upper and midzones, sputum showed numerous tubercle bacilli.

A. P. was induced on the right side as a palliative measure and as a last resort and though the right upper zone containing the cavity has not collapsed completely as seen by fluoroscopy, the general condition of the patient has improved beyond all expectation, his temperature is keeping normal for over two weeks, his blood condition has improved and he has gained a few pounds in weight.

V. Plate XIV is the skiagram of a man aet. 27 years. Onset with cough and fever 99°-102° F. for 2 months before admission. History of contact, 2 months ago, with his brother who died of pulmonary tuberculosis. Physical Examination showed signs of consolidation over right upper lobe only. Sputum showed tubercle bacilli. This patient had no A. P. treatment which he refused. Later he had waves of high remittent fever 101°-104° F. alternating with periods of intermittent fever accompanied by 4-8 loose motions in the day. He died in the course of six months.

Yet I venture to submit if A. P. were started on the right side and supplemented by a small volume pneumothorax on the left, if necessary, he might have, who knows, rallied up.

VI. Plate XV is the skiagram of a man aet. 28 years. Onset with "dysenteric" symptoms, for 9 weeks before admission, accompanied by cough and pain over right chest later. Physical signs disclosed the same picture as in the skiagram. Sputum showed numerous tubercle bacilli. The patient was in extremis. Yet, as a last resort, A. P. was induced on the right side. But the day after the first refill, the patient gradually sank and died. There were no complications due to the A. P. treatment and I am convinced, he died inspite of the treatment.

Such bronchogenic caseous extensions at the contralateral base, esp. the left as in this skiagram have a tendency to get worse under A. P. treatment, (CARPI, MATSONS and GRAVESEN)[13].

VII. Plate XVI is the skiagram of a man aet. 38 years who came in with fever 98°-101° F. for one month, cough and haemoptysis on two occasions, since a fortnight back, before admission. He weighed only 5 stone. 10 lbs. His sputum, at first negative, showed tubercle bacilli, four weeks later.

Physical signs showed medium and coarse crepitations over both lungs.

This is a case of tuberculose miliaire generalisee (LETULLE and BESANCON)[14]. It is a chronic affection with moderate fever, and slow evolution. The lesions gradually soften and then the sputum becomes positive to tubercle bacilli. The infection in such cases occurs by means of the pulmonary vessels of the lesser circulation.

Such a case is entirely unsuitable for A. P. treatment. The patient, in question, was observed in hospital for 9 weeks, to be getting worse and worse, after which he left the hospital, of his own accord.

I have, so long, confined myself to the treatment of bilateral cases by unilateral A. P. I would like to make a few remarks on bilateral A. P.

Bilateralisation of the disease, as a rule, occurs in 66% of cases (CARDIS) 14a.

In 18% of these bilateral cases, what is known as the crossed type, occurs.

In 60% of such crossed types, the initial lesion is on the right side and spreads as bronchial emboli to the left side (Vide Plate XIII.) In 40%, the spread takes place equally from the right side to the left and *vice versa*.

Plate X is a crossed form from left to right. In such crossed types, a small volume A. P. (ENTSPANNUGS) should be induced, at first, on

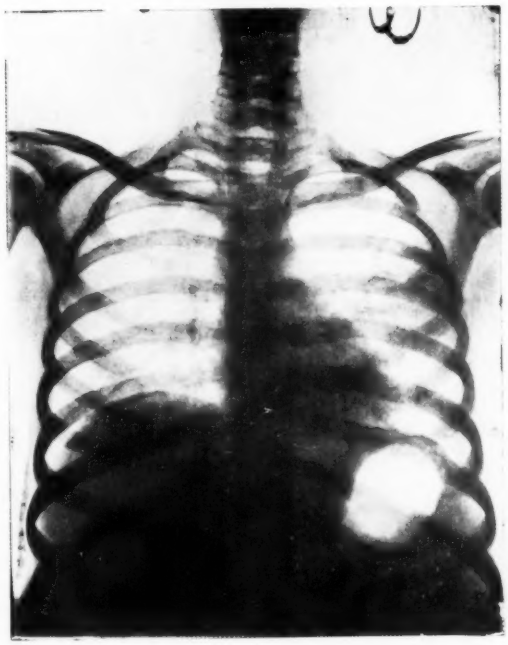

Plate IX.

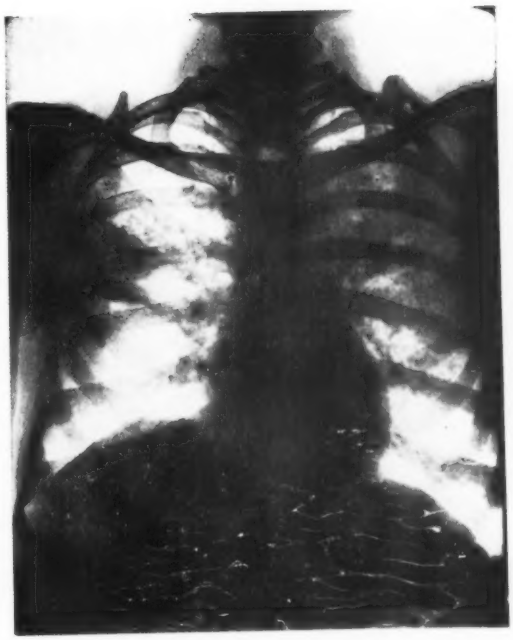

Plate X.

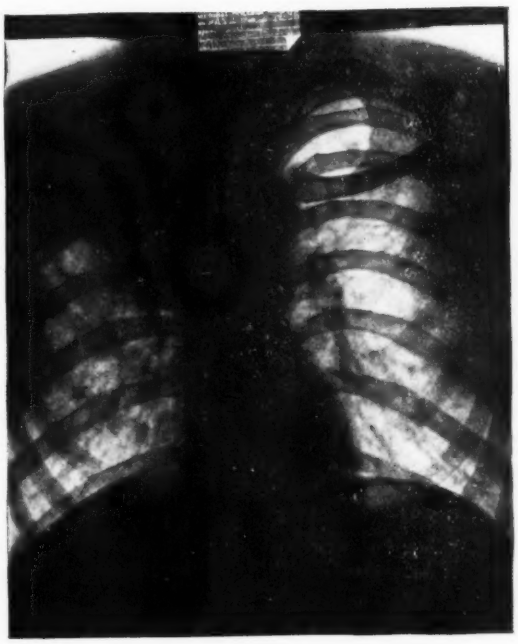

Plate XI.

Plate XII.

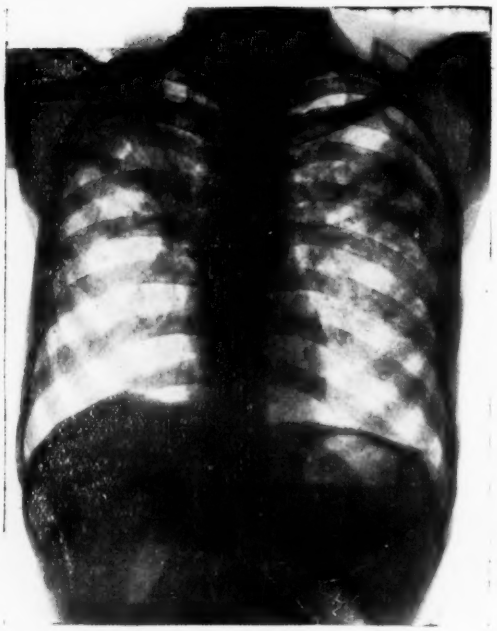

Plate XIII.

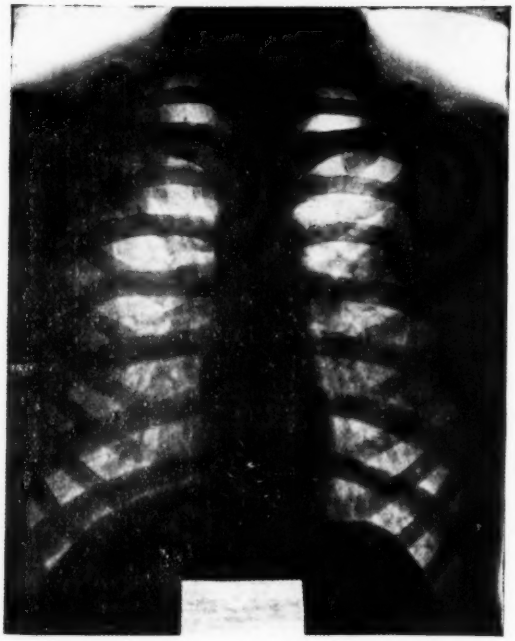

Plate XIV.

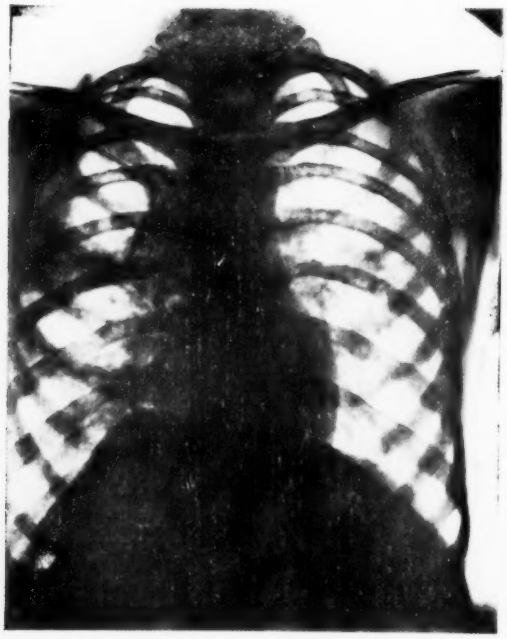

Plate XV.

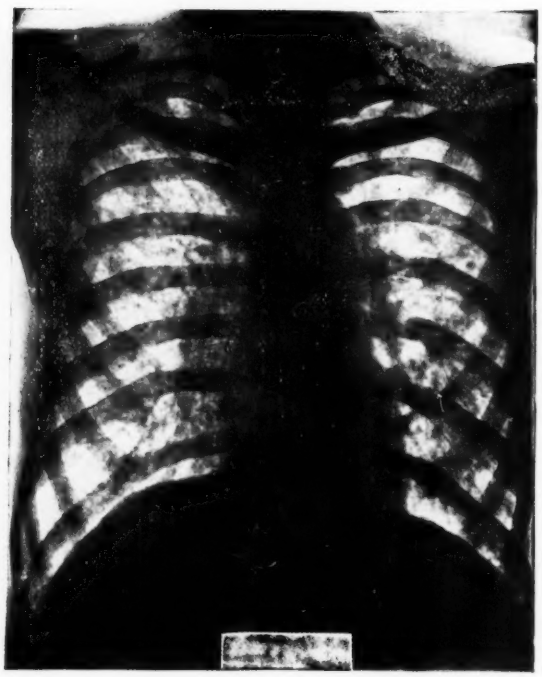

Plate XVI.

the side with more recent and evolutive lesions and later, if necessary on the side with older lesions.

GWERDER [15] holds also the same opinion. Therefore, in bilateral cases, before the induction of A. P. thorough clinical as well as radiological investigation by serial radiograms at intervals of six weeks or even three weeks, is essential to determine the side in which the lesions are more evolutive. A neglect of this principle leads to many unexpected fatal results.

Simultaneous induction of partial A. P. on both sides have, not however achieved much success.

SAUGMANN[16] reports one success in his series of seven cases and the MATSONS[17] report two successes in their series of fourteen cases. In the selection of cases for treatment by A. P., I have deliberately omitted to mention cases with small recurrent haemoptysis or severe haemoptysis. The A. P. treatment is a successful emergency measure, no doubt, for arresting haemoptysis but the suitability, of such cases for the continuance of the A. P. treatment with a view to cure, will ultimately depend on the actual extent of disease as shown clinically and radiologically.

CONTRA-INDICATIONS TO A. P. TREATMENT.

There are various contra-indications as described in text-books *viz.*—the association of the pulmonary lesion with laryngeal, intestinal and severe renal involvement of tuberculous nature, the association with respiratory diseases like emphysema and chronic bronchitis, and lastly the association with cardiac diseases and diabetes.

There are certain other conditions such as pregnancy and old age above 60 years which are often cited as contra-indications to the A. P. treatment. A very poor general state of health due to emaciation and cachexia is obviously a very important reason to withhold A. P. treatment.

The only contra-indication, so far as the state of the larynx is concerned, is acute miliary invasion (ST CLAIR THOMSON.)[18].

The intestinal tuberculosis, unless very severe does not contra-indicate A. P.

GRAVESEN, BRAUER and SPENGLER have recorded cases which have improved under A. P. treatment inspite of the intestinal condition.

In cases complicated with diabetes mellitus LEON BERNARD[20] has reported good results on a combined treatment of A. P., insulin and control of diet.

In cases of pregnancy, supervening on pulmonary tuberculosis, the best way is to terminate pregnancy before the 3rd month and then to start the A. P. treatment. After the 3rd month, a partial A. P. should be started and continued till induction of labour six weeks before term and then full collapse of the lung is to be kept up.

The most important and practical contra-indication to the A. P. treatment is, however, the presence of pleural symphysis which again can only be diagnosed with certainty by the failure to induce A. P. after 3-4 attempts.

The percentage of failures, immediate and remote, due to pleural symphysis, is 11·2—37·5.

COMPLICATIONS.

The complications, immediate and delayed, that may ensue the A. P. treatment, seem to be numerous on looking through the pages of a text-book. But, for all practical purposes, the two most important immediate complications that should be guarded against, both in the primary induction and subsequent refills, are :

(i) Pleural shock,

(ii) Gas embolism.

Even the occurrence of these two complications is rare. The former of these, can be rendered extremely unlikely by production of a complete local anaesthesia of the parietal pleura before the passage of the pneumothorax needle.

The latter is avoided by keeping the level of water in the gas bottle a little higher than that of the water bottle before starting the primary induction and noting that the manometer records

wide oscillations before the gas is allowed to flow into the pleural cavity.

The other complications of importance are :

1. Pleural effusion, serious or purulent, leading to pleural symphysis and to obliteration of the pneumothorax cavity. Such an occurrence took place in 10-12% of DUMAREST'S cases[21].

Slight amount of serous effusion that appears in about half the number of A. P. cases (Vide Plate XII) is absorbed spontaneously.

Large serous effusions and purulent ones are to be treated by gas-replacement and in the latter, if necessary, by oleothorax.

2. Spontaneous pyo-pneumothorax—due to rupture of the walls of a stretched septic cavern or due to breaking down of a superficial caseous patch into the pleural cavity. This is indeed a serious complication, urgent treatment by open drainage and subsequent total thoracoplasty is the only remedy.

3. Bilateralisation of the disease in the course of A. P. treatment.

Such minor complications as subcutaneous emphysema, moderate or severe pain in the chest after the induction of A. P. due to stretching or sudden separation of adhesions, and temporary marked rises of temperature after the operation, are not infrequently seen.

DURATION OF A. P. TREATMENT.

How long is the A. P. to be continued ?

It is an important question that has to be answered from a consideration of several factors :

1. Nature of the pulmonary lesion.
2. Degree of the lung collapse.
3. General condition of the patient.
4. Age of the patient.
5. Occupation.

If the pulmonary lesion is recent and localised, it would be quite unnecessary to maintain complete collapse for a prolonged period because it will hinder "Nature's efforts to produce hypertrophy of the healthy lung parenchyma". There is, indeed, a serious danger in allowing the healthy parts to atrophy, and definitively sclerose by a too lengthy compression in cases where the nature of the lesions permits the expectation of cure by resolution and effacement (JACQUEROD)[23].

Thus in cases of Fruh caverns, the continuance of refills may not be necessary for even 2 years.

BAER[23] reports two such cases, one with a Fruh cavern in the midzone of right lung and another with a juxta-hilar Fruh cavern in the right lower lobe similar to my case, (Vide plate IV) as completely cured after 16 and 6 months' A. P. treatment respectively. The restoration of the lung parenchyma to normal appearances was confirmed in each case by HAUDEK.

In some favourable cases, LEON BERNARD[24] (as quoted by BURNAND) has reported clinical cures after 10-15 months' collapse treatment.

However in cases of fibrocaseous lesions of moderate severity where healing can only be expected by total fibrosis and retraction, the A. P. is to be continued for 4 years at least (BURNAND and WECK)[25].

If the resulting lung collapse is complete, two years may be enough.

In younger patients of 16-25 years, the duration of treatment should be prolonged to, at least 4 years.

As a general rule, however, the minimum duration of treatment is according to—

GRAVESEN	2-3 years
DUMAREST	2 years
BURRELL	3 years.

AMREIN[26], of Arosa, reports of teachers, artists, carpenters and doctors who have their A. P. continued for 10 years or more and are still working at their full capacity.

The pneumothorax should be abandoned gradually under radiological control, when it is judged from the residual shadows that the lesions have been completely sclerosed and the clinical findings with regard to temperature, pulse and weight are satisfactory and the sedimentation rate has returned to normal limits.

A SURVEY OF THE END-RESULTS OF A. P. TREATMENT.

Before I discuss about the end-results of A. P. treatment of pulmonary tuberculosis, I would draw attention to the last five years statistics, of the Brompton Sanatorium at Frimley, which report that 80% of pulmonary tuberculosis cases with sputum positive to tubercle bacilli die in 5 years. From a follow-up one to nine years after the patient left the usual prolonged rest treatment at Arosa, RUGE and BERNSTEIN-KOHAN[27] recorded only 7·5% durable results at the III stage. Now, let us turn our attention to the following statistics [28] to study the end-results of A. P. treatment.

SAUGMANN finds from his material of 310 sputum positive IIIrd stage cases (1907-1918) :

	Treated by A. P.	Untreated due to adhesions.
Fit for work	33·9%	10·9%
Death from tuberculosis	59·3%	85·9%

Period of follow-up.	A. P. Cases fit for work.	Untreated Cases fit for work.
5 years	31%	17%
10 years	30%	0

Commenting on these figures, SAUGMANN remarks : "I do not know of any other treatment that gives III stage sputum positive cases a 33% chance of being able to work after 7 years."

DUMAREST records, in his series of 229 cases upto 1923, 56·3% favourable results.

BONZONI, in a collected statistics of 3,680 cases (1916-1925) from different clinics, records :

Cure 25% } 52% favourable results
Improvement 27% }
Death 31·29%.

IN MATSONS' 480 cases :

Clinical cure	32%
Arrest	20%
No Improvement	16%
Death	32%

It should be noted that the MATSONS use the term clinical cure to mean absence of activity of the lesion and absence of tubercle bacilli from the sputum persistently for a period of 2 years.

They have published another statistics showing the variation of end-results of A. P. treatment according to the type of the lesion, the character of the A. P. and the state of the opposite lung :

TABLE A.

TYPE OF DISEASE.	END RESULTS IN P. C.		
	Clinically Well.	Arrested.	Dead.
Fibrocaseous disease without cavity	40	16	31
Fibrocaseous disease with cavity	25	24	...
Caseous Pneumonia and Broncho-Pneumonia ...	23	3	3

TABLE B.

CHARACTER OF A. P.	END RESULTS IN P. C.		
	Clinically Well.	Arrested.	Dead.
Satisfactory Collapse ...	48	18	22
Partial Collapse	11	12	58
No free pleural space ...	5	9	66

TABLE C.

STATE OF OPPOSITE LUNG.	END RESULTS IN P. C.		
	Clinically Well.	Arrested.	Dead.
No disease	52	20	14
Active apical fibrocaseous diease	48	22	22
Quiescent apical fibrocaseous disease	50	24	20
Disseminated bronchogenic involvement of the lower lobe	26	26	33

BURNAND[29] reports in a series of 51 cases which have been followed up for 19 years :

With complete collapse 82% clinically well
With partial collapse 18% well.

As quoted by CARDIS.[30], STAUB of zurich Popular Sanatorium divides, into the two following groups, his series of cases treated from 1906-1923 :

In 1st group of 140 A. P. cases treated for 3 years 65% survival

In 2nd group of 66 (A. P. not possible because of pleural symphysis and with no other surgical treatment.) 10% survival.

CONCLUSIONS.

1. The collapso-therapy of FORLANINI should be applied in all cases of practically unilateral tuberculosis, when a preliminary course of conservative treatment by absolute rest for 2-3 months does not show any decisive evidence of regression, clinically and radiologically, in the nature of the lesion or does not give any assurance of a spontaneous cure or when such a preliminary rest treatment is not possible for economical reasons.

2. In bilateral cases, A.P. treatment should be adopted to check the activity of the disease, to render the patient more comfortable and to prolong the life in 25-30% cases. In these cases, good results are obtained only when a small volume pneumothorax is kept up on the side in which the lesions are more recent and evolutive.

3. It is not enough to induce A.P. It is necessary to keep the diseased lung collapsed for a long time. At first the gas is more quickly absorbed than at future fillings. So refills are necessary every 3. 5. 8. 12 days. later on every 3-4-5 weeks. These refills, at regular intervals and under radiological control, should be continued for at least 2-3 years. It must be emphasised that the end-results will depend on the nature of the lesion and the duration of the treatment.

4. Lastly, the A. P. treatment should not be left, till the end, to be employed only in hopeless and dying patients.

The success of pneumothorax treatment in future and the blessings that it can confer will depend on the promptness of early decision.

In conclusion, I wish to express my thanks to Lieut-Col. THAKUR, I.M.S., the Superintendent of the Howrah General Hospital, to Lieut-Col. KIRWAN, I.M.S., Superintendent of the Mayo Hospital, and to Dr. S. C. SEN GUPTA, Visiting Physician, Mayo Hospital for their granting me access to the case-records and to the skiagrams. My thanks are also due especially to the Radiologist of the Howrah General Hospital and to the House-Staff of both the hospitals, who have rendered me great help in the collection of materials for this paper.

SHORT NOTES ON THE SKIAGRAMS.

Plate I. Male. aet. 32 yrs.—Normal lung.

Plate II. Female, aet. 30 yrs.—Normal lung.

Plate III. Fruh-infiltrat of ASSMANN and REDEKER in the peripheral field of Rt. IInd. interspace.

Plate IV. Juxta-hilar Fruh cavern in the dorsal aspect of right lower lobe (arising from rapid ulcerative process in a juxta-hilar small broncho-pneumonic patch).

Plate V. Same case as IV. after partial A. P. on 3rd day after the primary induction. The cavity appears smaller.

Plate VI. Same case showing marked collapse of the Rt. lung which is lying against the lower dorsal spine. The cavity is no longer distinguishable except as a dense shadow merged with that of the heart.

Plate VII. Gross infraclavicular cavern over the upper and midzones of left lung surrounded by a dense opacity. There is evidence of fibrosis, due to which the trachea, mediastinum and the heart are somewhat pulled to the left.

Plate VIII. A diffuse opacity over the whole of Rt. lung with scattered infiltrations over upper and midzones of the same side. The right dome of the diaphragm is higher and the right costo-phrenic angle is obliterated. There is some displacement of the heart and mediastinum to the right. Left is normal.

Plate IX. Left lung shows infiltrations in the middle and lower zones both in the peripheral field and near the middle of the left cardiac silhouette with a cavern in the first interspace (not visible on the positive print)

Plate X. Lobite of the middle lobe of the Rt. lung with visible interlobar septum. Left lung shows massive exudative infiltrations of almost whole of the left lung except towards the base.

Plate XI. Rt. lung shows gross cavern in the middle zone with extensive fibrosis of the upper zone and with scattered infiltrations in the lower zone. Left lung shows scattered infiltrations all zones.

Plate XII. Same case after A. P. Incomplete collapse of the Rt. lung with some fluid at the base. The upper part of the lung is adherent to the chest wall by 3-4 membranous bands with a distinctly patent cavity in the midzone and two small ill-defined ones in the upper zone. Left lung shows no change from the previous one.

Plate XIII. Lobite of Rt. upper lobe with a small cavern and the curved interlobar septum. Left lung shows massive-infiltration of upper and mid-zones with evidence of breaking down in the mid-zone.

Plate XIV. A round opaque area in the periphery of the upper and midzone of the Rt. lung with cavitation in the centre. A similar opaque area with cavitation over the left middle zone.

Plate XV. Rt. lung shows a gross cavern over upper and middle zones with massive exudative infiltrations of all zones and tenting of the diaphragm near the Rt. cardiophrenic angle. Left lung shows diffuse exudative infiltrations of the middle and lower zones near the left cardiac silhouette (The latter infiltrations are not well seen on the positive print).

Plate XVI. Miliary tuberculosis of both lungs. (Tuberculose miliaire generalisee.)

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Koch's Fundamental Contributions to the Modern Understanding of Tuberculosis

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I. The Contagious Nature of the Disease.

It is difficult for doctors of the present generation to realize the tremendous revolution which the discovery of the tubercle bacillus by ROBERT KOCH in 1882 made in the conception of tuberculosis. How little the nature of tuberculosis was understood before this discovery may be illustrated by a remark of Professor C. GRAM (known specially by his differentiation of bacteria by his "Gram's" stain) to the writer when a medical student thirty years ago, that in 1881 his own professor when demonstrating a tubercular lung post-mortem said, that 'if one did not know better one would really be inclined to think by looking at such a lung that tuberculosis was a contagious disease'. This view was expressed by a medical authority one year only before KOCH proved the contagious nature of tuberculosis.

Immediately after the discovery of the tubercle bacillus the contagiousness of the disease was emphasized even to the point of over-emphasis with the result that at the present day the pendulum has swung almost to the opposite direction in some quarters, which may do great harm to the campaign against tuberculosis.

The present tendency is to stress improving of social and economic conditions of a people as the only really important factor in a national campaign against tuberculosis. Without minimising the importance of such improvements, it is still an undeniable fact that tuberculosis is largely a 'house disease', and one of the chief factors in a campaign is therefore the tracing out of sources of infection. As instances of the extent to which tuberculosis is a house disease the following examples will give a clear proof. In one of the town sections of New York with 80,373 inhabitants, 58·8 per cent. of all tuberculosis cases were found in only 10·5 per cent. of all the houses in that section. In Marburg in Germany, 34·2 per cent. of the consumptives lived in 2·6 per cent. of the 1,503 houses in the town.

II. 'The Phenomenon of Koch'.

While the most important of the discoveries of KOCH was undoubtedly the finding of the infecting agent of tuberculosis, he made another discovery which is almost as important and which is the foundation of the modern understanding of the immuno-biological processes of the disease. In 1891, KOCH gave a description in *'Deutsche med. Wochenschrift'* of what later has been called 'the Phenomenon of Koch'.

KOCH drew attention to the phenomenon that inoculated tubercle bacilli act quite differently when under the skin of a guinea pig already tuberculous than when under that of a normal animal. He described how nothing happens at the place of inoculation when tubercle bacilli are inoculated under the skin of a non-tuberculous guinea pig until about two weeks later. At this time there appears a hard nodule which soon opens spontaneously to produce an ulcer which persists until the death of the animal. Quite a different reaction is observed when the tubercle bacilli are inoculated under the skin of an animal already infected four to six weeks previously. As early as the second or third day the skin at the place of reinoculation becomes then indured and first violet red, and later blackish, over an area of from a half to one centimetre in width. During the following days the skin becomes necrotic, it soon sloughs and leaves behind it a superficial ulceration which heals rapidly and definitely, without the neighbouring glands becoming swollen. This totally different effect of inoculation of tubercle bacilli under the skin

of an already tuberculous guinea pig was not peculiar to living bacilli, but he found the same effect with inoculation of bacilli killed either by boiling or by chemical agents.

It was the observation of this phenomenon which later enabled KOCH to discover 'Tuberculin' and its use as a remedy against the disease.

Much more important than this, is the fact that KOCH'S phenomenon is the basis of our present knowledge of 'allergy', a word introduced by VON PIRQUET, and now prominent in medical literature and the key-word, so to speak, to the understanding of the immuno-biological changes taking place in a body infected with tubercle bacilli. The word 'allergy' means literally 'other energy', and indicates a condition of altered susceptibility of the cells which causes the organism to react to a second inoculation of an antigen in a manner different from its reaction to the first one. This allergic hypersensitiveness of the cells to bacillary proteins, produces an inflammation of exudative character round the primary focus of infection or round any subsequent foci of reinfection. Such an inflammatory exudation takes place in the lungs or anywhere in the body where the tubercle bacilli are implanted.

This inflammatory exudate is, when mild, a kind of defence of the organism against the infection. The bacilli which escape from the foci and penetrate into the exudate are destroyed by the leucocytes present there in great numbers or by the lysin produced by these. The exudate further stops the bacilli mechanically in their passage to lymph vessels and the blood. This is the reason why the lack of swelling of the regional lymph glands is not observed in KOCH'S phenomenon in the reinoculated animal.

The exudate might, as also seen in KOCH'S phenomenon be transformed to an ulcer or abscess which breaks out to the surface or in the lungs into a bronchus, and the pus, or the pus-containing sputum, is excreted together with the bacilli, resulting in rapid healing of the ulcer and formation of a solid, fibrotic scar. If the infection is very severe and spreads over a large area of an organ, this may be destroyed by the very process of the body's own defence.

The whole modern treatment of pulmonary tuberculosis consists of a careful regulation of the defence mechanism produced by the allergic condition of the body in such a way that the tuberculous proteins flow from the foci into the organism only to such an extent, but yet to that extent, that it can set up the inflammatory exudation round the foci just sufficiently to stop the spread of the infection and to convert the foci to solid scars, without simultaneously causing new areas of the infected lung to be destroyed.

The knowledge of the importance of the inflammatory exudation in tuberculosis, although based upon the phenomenon of KOCH, is very modern and has only been revealed by X-ray examinations of large numbers of tuberculous patients.

The exudation is often the very first manifestation of tuberculosis in the lungs. It can appear suddenly, within a few weeks, accompanied by high fever, clinically simulating pneumonia, influenza, typhoid, or malaria. It may also appear as a milder process, with low fever or with none at all, incapable of detection by stethoscopical examination, only to be detected by X-ray. Not only is the exudation to be seen in fresh infections, but it may also appear as an exacerbation of an old chronic fibroid type of phthisis and give cause to fever for two or three weeks with increase in other clinical symptoms. Thereafter the exudation may be absorbed, and the clinical symptoms may again subside leaving the patient only slightly worse, until after some months the process repeats itself, gradually breaking down the resisting forces of the patient against the disease.

It is of the greatest importance to know these inflammatory exudates in order to diagnose many early, but in fact the most serious cases of pulmonary tuberculosis. Usually these exudates often with cavities formed in a few weeks—appear below the clavicle. REDEKAR who examined over a period of several years more than 20,000 patients and healthy people by X-ray found that the tuberculous lesion, chiefly consisting of the

exudate, was as a rule located below the clavicle. The old conception that the first lesion of tuberculosis is located in the apices has long been given up, as modern research has proved the fallacy of it.

Typical illustrations of sub-clavicular infiltrations with inflammatory exudates are shown in the X-ray photos.

The patient whose chest is shown in *Photo I* came with a history of cough for four months and several short attacks of fever within that period. By stethoscopical examination nothing abnormal could be detected in the chest, while the X-ray examination showed a typical subclavicular inflammatory exudate with a marked cavity. The sputum was found to contain tubercle bacilli.

In *Photo II* is shown the chest of a patient with a large sub-clavicular exudation below the right clavicle, after only a few weeks' illness with fever and cough. Antiformin examination of the sputum revealed tubercle bacilli.

The two last *Photos III and IV* are of a patient who suffered from an old chronic phthisis without fever or cough. Suddenly high fever appeared simulating an attack of malaria. The blood showed no malarial parasites, but the X-ray examination revealed a marked inflammatory exudate below the old fibrotic cavity. The fever lasted three weeks and X-ray examination showed then disappearance of the acute inflammatory exudate and a condition of the lung as before the exacerbation of his disease.

It would carry us all too far to go deeper into the whole question of the modern conception of tuberculosis and its treatment, both of which have their basis in the work of ROBERT KOCH, one of the greatest geniuses in the whole medical history and the fundamentals of whose work will never be forgotten.

A Further Attempt at a New Anti-tuberculosis Serum

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"The beginning of Health is to know the Disease." There was a time when efforts at prevention and cure of tuberculosis were efforts without guidance, the source of the disease was unknown, the method of its attack obscure.

Then there came the epoch-making discovery by that great scientific spirit of Germany—KOCH—of the germ of tuberculosis, exactly fifty years ago, a strange coincidence—just a couple of months before this writer's birth.

All those wonderful "cures" thus disappeared, and it was now the "germ" which had all the attention centred on to.

Then came EHRLICH'S side-chain theory, and one of the world's greatest discovery in Medicine—again from that same land of Science—Germany *viz.* Behring's anti-diphtheritic serum.

No wonder, then, that attempts to combat the ravages of the White Plague were started on the same line—the glare and attractions of the great terms antibodies, antitoxins, precipitins, and agglutinins etc.—being too tempting to be allowed to pass by without due homage. The serving of human life and suffering is the greatest privilege claimed by the medical scientist. It is a divine prerogative for his ennoblement, and to it the profession owes its honourable position in the World. What a contrast between this army of medical scientists combatting death, and that other army of human beings whose object is destruction of life! Already the world is an insolvent debtor to medicine for what has been accomplished in the prevention of disease. The Angel of Death can no longer mow his wide scythe at will -the Plagues of Egypt are halted at the confines of civilization. The wonderful

Types of Subclavicular Infiltrations.

(Photos by U. M. T. SANATORIUM.)

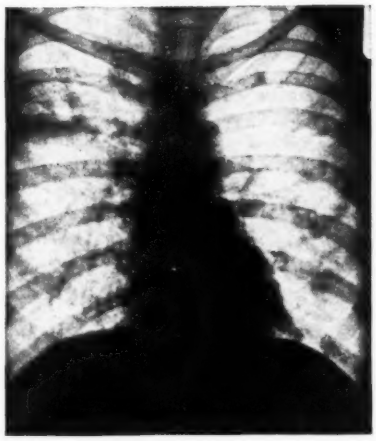

Photo I.—Early case with inflammatory exudate with cavity, below right clavicle.

Photo II.—Fresh and extensive inflammatory exudate below right clavicle, after 3 to 4 weeks of illness.

Photo III.—Chronic phthisis with old cavity above and below right clavicle.

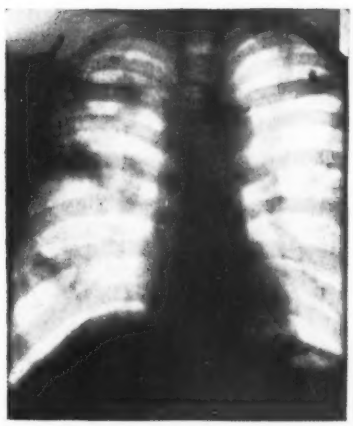

Photo IV.—The same chest as in Photo III showing an inflammatory exudate a little below the cavity. After 3 weeks the chest showed the previous condition by X-ray, the exudate having disappeared.

achievements with regard to malaria and the Panama Canal, and even so insinuating and chronic a disease as leprosy checked at the borders of civilization are instances of the noble efforts of the army of earnest devotees to medical science.

Tuberculosis differs from other germ diseases like small-pox, scarlet-fever, measles, whooping-cough, in the matter of immunity. The natural immunity with these diseases is weak, but a single attack of the disease is likely to establish an absolute and permanent artificial immunity. In the case of measles, it has been recently shown that the serum of a recently cured case confers both a curative and protective immunity, when injected into another child : but in tuberculosis, there is a natural immunity which varies not only in races but in communities, and even families. How this immunity comes, we know not yet. All the recent studies are now directed to this point, and in this alone perhaps will there be the solution of the problem of the eradication of this scourge of mankind. I well remember the case of an adult male with clinically extensive lesions in both lungs, in extreme poverty, living on road-side, occasionally taking up some sort of cooly-work trying to satisfy his hungercalls with hardly more than tea and loaf for days and days. But still I saw him alive for nearly ten years, keeping the same. I lost sight of him in the Influenza epidemic and it is to this that he must have succumbed. Every time on seeing him I picked him up and went into all the possible details. He always refused hospitalisation, preferring his free though more than semi-starving life. I can cite a number of cases like this, particularly in the elderly and poor class of patients. The only explanation that I can give is that the physical integrity of the individual may be maintained for a long period of time by some specific immune bodies in his system, with in addition and perhaps a more important factor—immune bodies whereby mixed infection is avoided.

The treatment of pulmonary tuberculosis is thus a very complex problem. Infection by bacillus tuberculosis is one thing ; but mixed infections bring in its train the "tissue destruction", and the hectic temperature, wasting, anaemia—that picture of "consumption."

Till surgery stepped into the field of the treatment of tuberculosis, there was no way out to cut short this "hectic" temperature, originating from the products of autolysis of tissue disintegration. Artificial pneumothorax and thoracoplasty have achieved wonders, no one can deny.

But can we attempt immunity against the "germ" B. tuberculosis—itself ? The importance of immunity as a factor in the cure of tuberculosis becomes evident when we consider that the "tubercle" is cut off from the circulation as soon as it is formed, and is very difficult to be reached by remedies circulating in the blood. It is only possible to attack the bacilli when they are free, before they settle down to form their new homes—the "tubercles". This progress of tuberculosis from ulceration and fresh colonisation by the germs can best be controlled through "immunity", and in the absence of an inherent immunity, attempts must be made for a passive induction. By creating immunity, we establish the best conditions for recovery, because we thus prevent the formation of new colonies. Immunity is, therefore, the ultimate object of all treatment, of tuberculosis. Maintenance of the integrity of the individual, and avoidance of complications the secondary, though in actual practice and treatment of a case, the immediate object.

The origin of serum therapy for tuberculosis is traced to HERICOURT and RICHET, who in 1889, began a series of experiments. It was found, at least supposed, that dogs possessed an immunity to tuberculosis, and it was therefore determined to inject their blood into tuberculous animals. Rabbits inoculated with Avian B. tuberculosis were given the dog's blood intraperitonially, and it was found to have certain protective influence. But this resistance to infection was augmented to a somewhat greater extent by injecting the blood of tuberculous animals. In the following year, BERTIN and PICQ upon the assumption of an immunity to tuberculosis by goats, transfused their blood into rabbits, with the

result that the evolution of the disease was retarded if the transfusion and inoculation were simultaneous. In 1901, dog's blood was used in France for the treatment of human tuberculosis, and apparently good results reported by HERICOURT, LT. HILAIRE, LANGLOIS, FENLARD, PINARD, LANDOUZY etc. Similarly goat's blood was employed by LEPENE, therapeutically ; but the results were not confirmed, by other subsequent experimenters. DAREMBURG tried to increase the immunity in resisting human T. B. infection in rabbits by the repeated injections of tuberculous dogs, but the results were unsuccessful. BABES in 1893, published cases where a prophylactic and curative influence was induced into experimental animals by the serum of dogs vaccinated against tuberculosis, and more than that, some excellent results were reported in localised infection in human beings, and in some cases with cavity formation. BERNHEIM tried ass' serum. REDON and CHENOT tried the sera of asses and mules after inoculating them with "tuberculous products," and favourable results were reported in experimental rabbits and in human cases as well. Numerous attempts were made by different workers using different animals : PAQUIN horses ; VIQUERAT mules ; AUCLAIR fowls ; NIEMAN goats ; DE SCHWEINITZ cows ; MCFARLAND asses.

MARAGLIANO devoted a long study in preparation of an anti-tuberculous serum, by injecting horses with toxins and dead bacilli. He argued that thus the serum is both antitoxic and antibacterial, and the proportions and thus the quality of the serum can be regulated by treating the animals by different doses of toxins and dead bacilli. The serum was standardised by its agglutination power. I myself had the opportunity of trying this serum on a fairly extensive scale nearly 20 years back and in different grades of the disease. But the results were in no way encouraging. Phips Institution report were as well not encouraging.

MARMOREK'S serum had been recommended about the same time ; but that too is no more mentioned. LOTHAM saw improvement some time after the discontinuance of the serum, and so attributed "vaccine" properties to it. FISCH'S serum too had its time and then given up.

SPENGLER came forward with his "immune bodies" in the red blood cells.

In 1920, I started working on the "chemistry" of the tubercle bacillus, and then thought of dissociating the fat (lipoid) extracted by hot ether, acetone and benzoyl chloride, and treating the defatted T. B. by ultraviolet irradiations. This latter was carried out in specially made quartz glass vessels made by the manufacturers of the Hanovia Alpine Sun-Lamp, all precautions being taken to avoid the effect of heat on the bacilli. The separated lipoids were similarly irradiated and emulsified in olive oil. Attempts were then made to use these two separately and conjointly in different proportions as active immunising agents. After a long series of experiments it was found that a large dose of the lipoid had a tendency in an active animal to set up an allergic pneumonic phase. Thus the dose had to be brought down to a certain level, and from start to the end of the course of treatment the same dose is kept up without any increase. The defated irradiated ground up (with sand) bacilli, after being confirmed of not holding up any acid-fast covering were suspended in saline and diluted in strengths of 1-10ths like the usual tuberculins, and used in progressively increasing doses,—in an ordinary case with low or no pyrexia increasing the dose in arithmetical progression under very strict supervision. This latter of course requires great caution and constant supervision. This is the tuberculin with the fixed proportion of the irradiated lipoid that is in use at the "Bel Air" Sanatorium at Panchgani for the last ten years. Some years ago, a paper was read at the Bombay Medical Union meeting describing nearly a hundred cases with serial radiograms.

The standard dose of the lipoid remains fixed at 0·000005 grm ; whilst the defatted irradiated bacilli (ground up) represent 0·00003 grm. in 1c.c. saline represent the stock solution, from which the different dilutions of 1 in 10 are made, the preliminary dose being 0·1c.c, to 0·5c. c.c. of 6th. dilution. The injections at first being made

every 4th. day—with longer intervals with 4th and 3rd. dilutions. A well progressing case in an institution where he can be well watched goes up to full 1 c.c. of the 2nd. dilution.

Considering the very favourable results from this combined tuberculin, and with the most willing undertaking by the Behring Institution of Nurenberg, the project of manufacturing an anti-serum was thus undertaken. The Behring Institute with all the spirit to scientific research gave up all the charges in regard to their scientific services though they were fully entitled to that according to the previous arrangements, even though the whole process stretched out into a very long period. The details in the immunisation of the animal are given at some length, as well as the post-mortem reports of these animals. All the animals were previously tested by Tuberculin tests.

No great hopes, from the start, were entertained as to any specificity in the serum, as with all the recent work, the general trend of opinion is in favour of "cellular immunity," and more recently, "chemical" variations in the body. As expected, no curative results can be obtained from the serum in pulmonary tuberculosis. And here too it was again noticed that it often seemed to behave like a vaccine, the same as observed by LATHAM in MARMORECK'S serum.

On SPENGLER'S theory of "immune bodies" the extracts of the red blood cells of these animals were as well tried. My object in giving these details is to show that the question of an anti-tuberculous serum is rather not a possibility. May be, some other method may succeed. But anyhow in pulmonary tuberculosis, as stated above, the question of mixed infection, the caseo-suppurating mediastinal glands (which, of course, cannot be attacked even surgically), the absorption of the autolytic products of tissue destruction, anaemia, degeneration of the cardiac muscle, fatty degeneration of the liver, the intestinal lesions and what not that we see in an advanced case, that is unfortunately our lot in India to see in the majority of cases, is there any possibility of any specific serum to give any chance of success ? In fact, is there any chance of realising our hopes of a succesful treatment from a serum or a drug with the above pathology of an advanced case ?

What can then be the solution of the question ? The number of existing cases of the disease at any time must be about five times the number of total annual deaths. And roughly one-seventh of deaths may be referred to pulmonary tuberculosis (CORNET). It makes its appearanee in no overmastering raids like the dreaded plague and cholera and with none of the horrors of a sudden catastrophe, and no other disease affords an equal number of victims, nor does any other in equal degree spread want and misery from prolonged illness, through wider circles. It is stated that each year the world yields up 1,095,000, each day 3,000, each minute 2 of its people as a sacrifice to this plague. The subjects are mostly at the most useful and responsible period of life, young men and women, many of them married, with children to support and rear. Independently of sentiment, the economical loss due to it, is tremendous. It is when the working time of life has come "when the baby has been nursed into school-age, when the school-boy has become an apprentice, when the apprentice has learnt his trade," and has entered upon the years when he should begin to repay all the parental care and discharge his duties due to the State, it is then, that he is struck down by consumption. It gathers its victims to an extent of more than 75% from the bread-winners.

Prevention and so "Isolation" is for the present, our only solution as regards the poor and illiterate classes in our country ; the question is really an important one. Such poor unfortunate ones have to earn their livings—a day's earning lost being too much to them. They are almost half-starved, suffering from the ravages of a merciless disease—shivering, burning, sweating, aching and fainting day in and day out, always in the harness, doing their day's work in a mechanical way because they are spurred on by sheer necessity ; working all day, coughing all night, spitting here spitting there, how can they concern themselves about preventive measures and grasp its meaning. What they need is a kind,

sympathetic helping hand to save them from this state—removal from their holes, holes which they call homes.

How essential then for the carrying out of this is the nessessity for State Hospitals and Sanatoria supported by public funds and the richer classes of the community. It is indeed the most important, the most far-reaching, and as well the most humane of the measures. And is anything done in our country? The State must be made to see in this a duty, rather than a charity. The rich must realise their share of the duty as well. When a person contracts tuberculosis his life is jeopardised by a disease which is preventible, which the State is in duty bound to prevent. The public has a right to demand hospitals for advanced cases, there is rarely any hope of cure in such, but they are entitled to such alleviations of sufferings as humanity dictates and science can give. Great sacrifices are demanded of them for the protection of the general public, and these sacrifices add materially to their sufferings, both mental and physical. What better return can a community make for the benefits which it derives from exemption from the disease, than an asylum in which their sufferings may be mitigated. It is the community in the end which becomes the chief benificiary of the hospitals in the security which it gains. A government never hesitates to provide liberally for those persons and their dependants who have endangered their lives in war for the good of the country. Why should it hesitate to provide for those whom it asks to make an equal, if not greater, sacrifice in time of peace. In the light of science a tuberculous subject has a greater claim upon the better-off members of the public and the government than the soldier, because he makes his sacrifices for the public good, in keeping himself away from the world at large to prevent infection, without emoluments and glory, whilst the soldier receives a modicum of each. (HARE).

APPENDIX.

Cow No. 207 (250)

Immunization with 10% Lipoid solution.

Dried human and bovine tubercle bacilli were extracted by acetone, again dried and then extracted by methyl-alcohol. The residue of this extract was emulsified by saline solution up to 10%.

28th October 1926	10c.c.	10% Lipoid solution.
30th "	20c.c.	
2nd Nov. " 1926	40c.c.	
5th "	80c.c.	
9th "	150c.c.	
27th "	200c.c.	
2nd Dec. 1926	300c.e.	
14th Dec. 1926	0·4 gr.	dead human bacilli of an avirulent strain I.
23rd "	0·8 "	
30th "	1·5 "	
26th Jan. 1927	1·5 "	
2nd Feb. "	2·0 "	
11th "	2·5 "	
29th March 1927	1 mgr.	avirulent strain I treated by ultraviolet rays.
1st April "	2 "	
5th "	10 "	
9th "	20 "	
13th "	40 "	
20th "	80 "	
4th May 1927	100 mgr.	relatively virulent human strain III treated by ultraviolet rays.
10th "	200 "	
17th "	400 "	
24th "	800 "	
14th June 1927	10 mgr.	living strain I
22nd "	100 "	
28th "	1000 "	
20th July 1927	10 mgr.	living strain Tb IV (human) virulent.
29th "	100 "	
6th Sept. "	1000 "	I culture of very virulent strain R. human strain.
7th October "	2000 "	
21st " "	4000 "	

8, 4, 11, 17 November bleeding each time 2 Liters

24th January 1928 I Culture Tb. strain R.
14th February " 2 Cultures " " "
16th March " 4 " " " "

26, 29, 31, March, 3 April bleeding each time 2 Liters
18, 20, 23, 25, April " " " 3 "

24th May 1928 490 kilo weight

15th " " Testing for immunity against very virulent *bovine* strain. 1-10 of an agar slope culture no reaction slight increase of weight.

22nd June " Temperature increased for 10 days and gradual loss of weight.

8th August 4 cultures of living strain R.
and 4 " " dead " "
loss of weight till 440 kilo on 22nd August

8th October 15 cultures of living Tubercle bacilli.
virulent bovine and human a a.
slight temperature loss of weight till 423 kilo 16th October

9th November Bleeding 3 Liters
20 " " to death 17 Liters of blood.

Report on the results of the dissection of the Tuberculous cattle No. 207.

Cow No. 207 was given on Oct. 8, a subcutaneous injection of 100 c.c. NaCl solution containing 15 cultures (agar slope) of human and 15 of bovine Tubercle bacilli. The animal got some rise of temperature not exceeding 39·8°C. with some loss in weight, which however had been made up again on Nov. 9, when a trial bleeding was made partially under addition of citrate of sodium.

On Nov. 20, animal was bled to death, yielding 17 Liters blood, and 6·8 Liters serum.

The post-mortem of the cow No. 207 gave somewhat different findings compared to those of No. 208 and 209, which cows had no trace of tuberculous processes to be seen. Cow No. 207 showed a tuberculous focus of about the size of a fist in the right lung, containing caseous material, in which Tubbercle bacilli could be found.

There was a small and calcified tuberculous focus in the mediastinal lymph-glands, but otherwise nothing abnormal could be found, and everything else corresponded exactly to the findings obtained in cow No. 208 and 209.

Cows No. 208 (160 kilo)

1	Nov. 1926	10 c.c.	10% Lipoid solution.
3	"	20 "	
6	"	40 "	
10	"	80 "	
27	"	50 "	
2	Dec. 1926	80 "	
7	"	150 "	
14	Dec. 1926	0·1 Gr.	killed strain Tb. I.
23	"	0·2 "	
30	"	0·4 "	
25	Jan. 1927	0·4 "	
2	Feb. 1927	0·6 "	
11	"	1·0 "	
28	March 1927	1 mgr.	Tb. I. treated by ultra violet rays.
1	April 1927	2 "	
5	"	10 "	
9	"	20 "	
13	"	40 "	
20	"	80 "	
4	May 1927	100 mgr.	Tb. III. treated by ultra violet rays.
10	"	200 "	
17	"	400 "	
24	"	800 "	
14	June 1927	10 mgr.	Tb. I living.
22	"	100 "	
28	"	1000 "	
20	July 1927	10 mgr.	Tb. IV living *308 kilogr.*
28	"	100 "	
10 to 18 August		Bleeding	4 × 1·5 Liters.
30 Aug. to 7 Sept.		"	4 × 1·5 Liters.
8 Oct. to 14 Oct.		"	4 × 1·5 Liters.
21 Oct.	1927	100 mgr.	Tb. 4 living.
1 Nov.	1927	200 mgr.	
9 to 17 Nov.		Bleeding	4 × 1·5 Liters.
24	Jan. 1928	10 c.c.	*(400 kilo).*
31	"	20 "	
7	Feb. 1928	40 "	*Nucleoprotein solution (marked fever reaction)*
18	"	80 "	
28	"	100 "	*(425 kilo).*
15 to 22 Mar. 1928		Bleeding	4 × 2 Liters
5 April		395 kilo	
24 May		440 "	

slight temperature due to some illness—transitory loss of weight.

17 July 435 kilo

23 July testing immunity with injection of 100 mgr. living Tb. IV., rise of temperature for about 2-3 weeks, but no loss of of weight

15 Aug. 1928 Bleeding to death.

Report on the results of the dissection of the Tuberculous cattle No. 208.

Cutis and Subcutis: On the whole without any findings. Only near the last site of injection subcutaneous, solid, brownish-yellow nodes of about pea-size were to be seen, singularly and in conglomerates. (Material for the histological examination). Microscopically, no inflammation around these nodes was observed.

Thorax: With exception of fibrotic glomerules of the pleura costalis alongside of the costal section of the heart and the pericardium the serous membrane of the thorax was without changes. Heart and lungs were without findings. One bronchial lymph-node appeared twice as large and more solid than normally. (Material for histological examination).

Cavity of the abdomen: Serous membrane, and all organs of the abdominal cavity without findings. Some mesenteric lymph-nodes showed 2-3 bleedings of pin-head size on the cut. (Material for histological examination). All other lymph-nodes of the muscular tissue and the body, the heart and its cavity and the skeleton were without findings.

Cow 209 (187 kilo)

3	Nov. 1926	5c.c.	10% lipoid solution
8	"	10 "	
13	"	20 "	
27	"	20 "	
2	Dec. 1926	40 "	
7	"	80 "	
14	Dec. 1926	0·2 g.	killed Tb. I.
23	"	0·4 "	
33	"	0·6 "	
25	Jan. 1927	0·6 "	
2	Feb. "	1·0 "	
11	"	1·5 "	
29	March 1927	1 mgr.	Tb. I treated by ultra violet rays
1	April "	2 "	
5	"	10 "	
9	"	20 "	
13	"	40 "	
20	"	80 "	
4	May 1927	100 mgr.	Tb. III treated by ultra violet rays
10	"	200 "	
17	"	400 "	
24	"	800 "	
14	June 1927	10 mgr.	Tb. I living
22	"	100 "	
28	"	1000 "	
20	July 1927	10 mgr.	Tb. IV living
28	"	100 "	

240 kilo

11—18 August		Bleeding	4 × 1·0 Liter
30 Aug.—7 Sept		"	4 × 1·0 "
8 Oct.—15 Oct.		"	4 × 1·5 "
21 October	1927	100 mgr.	Tb. IV living
1 November	"	200 "	
9 to 17 Nov.	1927	Bleeding	4 × 1·5 Liter *280 kilo.*

24	Jan. 1928	10 c.c.	Tb. Nucleoprotein. (fever reaction) *360 kilo.*
31	"	20 "	
7	Feb. 1928	40 "	
18	"	80 "	
28	"	100 "	

15 to 22 Mar. Bleeding 4 × 2 Liter
25 May 50 c.c. Tb. Nucleoprotein
1 to 8 June Bleeding 4 × 3 Liter *425 kilo.*
23 July 100 mgr. Tb. 4 living (No reaction)
13 Sept Bleeding to death

300 c.c. of the Nucleoprotein solution contained the protein of 5 Gr. dried Tubercle bacilli.

Report on the results of the dissection of the Tuberculous cattle No. 209.

Cow No. 209 was bled to death on Nov. 23, and a post-mortem examination made with the result, that so far nothing could be found indicating an active tuberculous process and even no traces of old, inactivated, tuberculous process could be found, neither in the glands nor even at the site of the injection, the animal must have been immune to bovine and human tuberculosis in the same degree as the animal No. 208.

Pathological Institute

MARBURG,
August 17, 1928.

J. Nr. 747/28.

DR. DEMNITZ, *Marburg.*

The two lymph-nodes of the lungs, which were sent in, do not show any tubercular reactions of the tissues, the same also refers to the lymph-node of the mesentery, which inwardly partly shows fibrotic changes. The changes of the pleura costalis consist of fibrotic strings, grown together probably due to a previous pleuritis. Tuberculosis also here cannot be proved. The site of vaccination clearly shows tuberculous nodes partly in groups of several together which partially have become caseous and the larger part of which again has calcified. The nodes themselves are well defined and appear as capsuled.

Sd/- Prof. VERSE.

Points in the Prophylaxis and Treatment of Tuberculosis

By DR. NALINIRANJAN SEN GUPTA, M. D., (Calcutta.)

PROPHYLAXIS.

In the prophylaxis and treatment of tuberculosis here, one has to remember that tuberculosis as we see it in India is a very different disease to the tuberculosis that prevails in Europe today. Although an ancient disease in both continents, tuberculosis in Europe started on an almost epidemic course early in the last century after industrialisation of Europe had commenced after the close of the Napoleonic wars, *i.e.* when the first chimneys began to be erected for the cotton mills of Lancashire, and for the first silk factories in France and later on about the time when coal began to be the pivot of Germany's industries. All the horrors now attended with T. B. dissemination in India used to be witnessed in the slums around these industrial centres. Naturally the death rate was extremely heavy, probably heavier even than in India now. A gradual process of natural immunisation started and from about 50 years ago forces of immunity have become more powerful than those of infection and in consequence "Propagandists claim that the Captain of the men of death is dying out."

In India on the other hand industrialisation, the growth of towns on the Western model and mechanised transport with mixing up of large masses of people in crowds are of recent growth. Infection is therefore just beginning to make itself felt and immunity has not had time to assert itself. The deplorable consequences of this urbanisation and industrialisation similar to those seen in Europe in the last century, are only just beginning to be manifest every where.

In a very interesting monograph (for the Medical Research Council 1930, Special Report 149) DR. H. H. SCOTT has compared the lesion in wild animals infected with T. B. and that in domesticated animals and also of Eastern races like the Chinese with Western races. In every one of his 300 post mortems on Chinese the most striking fact noticed is the enormous difference in the infectivity and the severity of the lesion in the non-immune Chinese as compared with the immune European races. The amount of virulence, the severity of the infection, the rapidity of the course and the tremendous death rate seen amongst races freshly infected from contact with the West—such as the Chinese and the Indian—

have to be seen to be believed. MORISTON DAVIES says that pulmonary tuberculosis seen in the adult in England is rarely a primary infection, it is a reinfection of an old focus of childhood. Here in India we may say it is generally a fresh infection and rarely a re-infection. Again tuberculosis in old people has been described as being an entirely different disease to tuberculosis seen in young people (Tuberculosis Annual Meeting March 19, 1930.) It is easy to see then how different Indian tuberculosis which is comparable to tuberculosis in the young must be to tuberculosis in Europe which is parallel to tuberculosis in the old.

In addition to India being thus a comparatively virgin field for the ravages of the T. B. certain outstanding factors in devitalisation have assisted in the process. The first undoubtedly the foremost is Malaria which in addition to causing a million and half deaths per annum is responsible for an untold amount of devitalisation in the people who escape death but survive to suffer which means practically wrecking the health of a whole nation. The next factor is industrialisation with its squalor, its filth, its tenements and the week-end boozing all typically Western in conception and execution. The third factor is the construction of houses in foolish imitation of the West without verandahs which used to constitute under the name of verandah (for pucca houses) or *Dawa* (for katcha houses) the main place of residence night and day except in inclement weather. Rooms were then often badly built with small windows no doubt but rooms were meant principally for security of valuables and not for residence in those days. A courtyard for the Zenana was considered an imperative necessity. But such out-door life has been practically abandoned with the new way of planning houses on Western models without verandahs and courtyards. The setting up of pucca school buildings in place of the open-air-village-pathsalas has been another nail in the coffin of the outdoor life of the young, serving to imprison the little scholars for hours at a stretch in small stuffy rooms. These conditions in school are materially helped by a nation-wide insistence on University degrees for girls as well as boys resulting in the anaemic look, the thenoid chest, myopic eyes all of which furnish in no small degree a definite ground work for T. B. in the rising generation. Whatever the reason might be, it is our experience, and it will probably be borne out by many of my colleagues that the training of girls in particular, for University degrees leads not uncommonly to physical conditions which are very favourable for the T. B.

The next factor is the throwing overboard of old dietetic principles of fresh natural food with plenty of vitamins and their replacement by new untried ones, again in senseless imitation of the West—tinned, bottled, supercooked and the almost universal adoption of tea which has practically no food value whatever. Also adulteration of our vital food stuffs, a pernicious process only possible in present day Indian conditions, has definitely come to stay. The net result is starvation of vitamins and of essentials which can not fail to show its effects on our tuberculosis statistics. Again, public dining at restaurants with its easy possibility of transference of diseases so long interdicted by salutary social traditions, is now fast coming into favour in cheap imitation of Western methods and the attitude has undoubtedly helped the spread of diseases and extension and frequency of epidemics. Finally the moral factor is not to be overlooked. I may be excused quoting myself here (Presidential speech, Nadia Red Cross). "The constant succession of stimuli and shocks to the nervous system which modern condition of 'Civilised' life impose on us, the constant and unceasing struggle for existence with its intense and ever increasing keenness, the falling off from our lofty idea into narrow and self-seeking grooves with its race war and class war have all combined to induce the strain on the Kata-Endocrines, the Thyroid, the Post Pituitary and Adrenals necessary for the production of tuberculosis. In more comfortable circumstances strain on these endocrines leads to diabetes and hypertension. Similar conditions in Europe and America have led to an alarming increase in

apoplexies, heart failures, lunacies, suicides and murders. With our long heritage of quiet and peace, of serenity and renunciation, we are all the more unfitted for this feverish anxiety for the pleasures of the flesh, and naturally we fall an easy prey to the grief and disappointment, that they bring in their train. Economic conditions have also undergone such a drastic change that the vast majority of our countrymen are half-fed and ill-nourished. A handful who are really above want, have had their ideals of life so altered, that with them life is but a kaleidoscopic succession of engagements and amusements. Without paying a thought to their suitability, much less to their utility they try to ape European manners and customs and are closely followed in this race for blind and pernicious imitation by people who are below them in the social or the economic scale. The result has been a regrettable perversion of our ideals. It has now become our aim to make the most of the present, forgetful of the future, and the future in its turn forgets us and the present forsakes us."

With a disappearance of moral control and with a new outlook in life which regards parental control as a slur on the intelligence of the young has disappeared the most effective restraining factor in the sexual life of young married people. What would have appeared a truism to Indians of the old school *viz.* continence during the last 8 weeks of pregnancy now requires a Professor (MITRA, Journal of Indian Medical Association, January 1932,) WALTHARD of Zurich who by appeals and lectures has insisted on sexual continence in the last 8 weeks of pregnancy. It is obvious that under present conditions the learned Professor's appeal must fall on deaf ears. No wonder *sutika* and pregnancy-anaemia the result of uncontrolled pregnancies even in the very sick and ailing and of other indiscretions are naturally rampant and tuberculosis finds its victims by the million amongst our young mothers.

It is the fashion now a days to decry some of our ancient social customs and practices as being essentially responsible for the high tuberculosis death rate. A little examination will show, however, that our critics are speaking without their books and facts are entirely otherwise. The inevitable first results of urbanisation and industrialisation affect India as they affected Europe, the only difference being one of time. Europe started getting immunised about 80 years ago and India is only just beginning to do it. Similarly early marriage, the *bete noir* of our foreign and domestic critics is universally held responsible for the high mortality rate of girls in this country. But surely no one will acuse English girls of suffering from the disability of the Purdah and of child marriage. How then are we to explain the singular fact that in Great Britain also the rapid decline in tuberculous mortality has not been accompanied by any corresponding improvement in the tuberculous death rate of girls between 15 and 25 years of age who are still dying in relatively greater numbers? Indeed in recent years in some districts the deaths have been actually more numerous. BURTON WOOD of the Victoria Park Hospital commenting on this high death rate in girls says (Lancet October 4, 1930.) "The cause of the high mortality in young girls is unknown." Evidently then the high death rate amongst girls is a world-wide factor. Is it not poor logic, to be ready with an explanation for the death rate in this country and to offer none for the same events in another country? Such a course of reasoning might suit propagandists and stump orators but not men of science. Again when we find that the death rate and infection amongst the Chinese mounting up at the same rate as amongst us, although they suffer from none of the disabilities of the purdah, caste and child marriage, we feel that the suggestion that early marriage, caste system, the purdah and religious practices are the causes of a high tuberculosis death rate in this country must be the outcome of sheer unreasoning prejudice. Finally, men who are supposed to know what they are talking about are surely aware that Indian Christians in the city of Calcutta have a much higher death rate and incidence rate than the Hindus,

(death rate from Christians per 1000, 4·7; Hindus per 1000, 2·8). If deduction from statistics had any logical basis we would have surely found our experts ranged in favour of the same social customs and speaking up for early marriage and the purdah and our social life, instead of carrying on a campaign against these practices.

We must, therefore, beware of accepting shibboleths about faulty social customs and early marriage at their face value and look to the real culprit in the case *viz.* Western Civilisation and its baneful impact on the serene tenor of life of Eastern peoples.

The real prophylaxis, therefore, against tuberculosis lies not alone in the isolation of the patient nor in the attempt to eradicate that most deadly of scourges Malaria—important as they undoubtedly are.

The anchors that have held for centuries must not be let go. Parental control over the young, refusing to make a fetish of pleasure, abandonment of imitation of West in principles and in details of our life these are essentials if the change from a simple rural uninfected population to urbanized civilization has to be robbed of its terrors during the period of transition.

Cottage industries as against factories should be helped, residence away from towns encouraged, compulsory provision of verandahs and court-yards in all houses should be made, the crowding and the excitement of sight seeing at foot-ball matches should be avoided and the wholly immoral and physically evil atmosphere of the stuffy cinema should be banned specially for children. Milk diet specially for children should be encouraged. Imported tinned food and tea should be avoided and dining at restaurants condemned. Organised attempts should be made for improving the appalling housing conditions of the poor in the cities and industrial towns. If all this is done it is possible that the process of industrialisation of 300 millions of people may be rendered as safe as it possibly can be.

Finally the provision of more centres of treatment by the State and by the public bodies, the diagnosis and removal to sanatoria and to these centres of the early as well as of the late cases which are undoubtedly the most effective method of segregation of the infected from the non-infected, should not be made to wait for better days. We all know how kala-azar was brought under control by treatment of cases initiated by public and private bodies on a large scale and not by any preventive measures. Without claiming anything like the same measure of success it may safely be said that removal to and treatment at recognised centres will go a great way in removing the potential and active sources of infection and should not be made to wait for so called educative efforts.

Treatment.

Our notes here are based solely on the results of treatment on an unselected group of 200 cases in my practice with different therapeutic agents. For the purposes of this paper, only patients who, in addition to positive physical signs were radiologically positive or where the sputum was positive, have been included, while cases in which insufficient treatment with an uncommon therapeutic measure was given have been excluded. The most striking fact which one is up against in considering these results is that therapeutic measures which have proved more or less successful in Europe rarely show anything like the same results in India. Also that considerable modifications in methods and in doses have to be adopted to make them free from risks principally for the reasons mentioned in the beginning of the paper. The cases are so severe, bilateral lesions so much more common that only a small percentage of declared cases yield even to the best possible treatment. We are told that the results in certain Indian sanatoria are even better than those of similar places in Europe. Without meaning any reflection on any body concerned, I can only suggest that the favourable result may be due to the inevitable exclusion (considering the long journey involved specially when Bengal is concerned) of the common type with high temperature and multiple lesions, and acceptance of the more chronic type with low-

temperature the selection of cases thus approximating to those normal in Europe.

Rest : For example the most important therapeutic measure is undoubtedly rest. The effect of rest on the tuberculous temperature is well known but in our cases here we are seldom or never able to bring about a complete disappearance of tuberculous temperature in a declared case from rest alone. As rest alone was never given a trial in any of the cases in this series it is difficult to give specific details about the influence of rest alone on the temperature but from the insufficient trials made, we noticed that not more than 2 to 3 per cent of cases showed anything like a complete and steady drop in the temperature chart after rest.

Tuberculin : It is obvious that under conditions described above where the patient is already deluged with Tuberculin from his own system further injections of Tuberculin are not called for and may actually prove dangerous. Tuberculin was tried in only two of my pulmonary cases. The result in both cases was either nil or bad. Unfavourable results in some earlier cases had already discouraged me in the use of this agent in P. P. and although I may not wholly admit the dictum of (Mitchell Lecture, Nov. 1930) BURELL that it is "Of little value excepting as a diagnostic agent", I find its use accompanied by reactions which are better avoided by not using Tuberculin generally in P. P. cases.

Cutaneous Tuberculin : The susceptiblity of our Indian cases is very well shown by the development of well marked focal and general reactions after the application in very minute doses of cutaneous Tuberculin prepared by a well-known German firm in two successive cases in this series.

Calcium : Calcium was tried orally or by injection or a combination of both in all the cases. The result depended on the type of case met with. In a little less than 10% of the cases Calcium was found to be unsuitable in whatever shape it was given. This 10% of cases in which Calcium did not agree comprised mostly patients with (1) comparatively high continued temperature and a rapidly extending pulmonary lesion and also (2) patients with dyspepsia and symptoms of colitis and enteritis. In these groups there was definite exacerbation of symptoms after injections of Calcium. Again Calcium was found unsuitable in the type, (3) with high fever and haemorrhage, the haemorrhage actually getting worse after each Calcium injection. I have found the Blood Calcium in T. B. cases in Bengal to vary from anything between 8·5 to 11·5 m. g. per 100 c.c. (in one case it was 12·8 m. g.) the latter figure by the way being very much higher than the average that I found for a normal Bengalee. The cases most suitable for Calcium treatment were mostly those with high Blood Calcium figure but this is not always the case. Sometimes patients with Blood Calcium of 8·6 m. g. were also found to react unfavourably to Calcium. Generally however patients with low Blood Calcium did well on Calcium treatment. Clinically it may be stated that patients with low temperature and moist lesion are most suitable for Calcium treatment.

(*a*) Oral : Orally Calcium was given mostly as the lactate or the hypophosphite. It was often combined with parathyroid. It is theoretically questionable however if parathyroid administration is indicated in a case of pulmonary tuberculosis. It certainly rapidly raises the Blood Calcium content but as the desideratum is the charging of tuberculous tissues with Calcium, parathyroid administration which mobilises the Calcium of the tissues and collects them in the blood should not be of any help and on the contrary should be contraindicated as it may actually denude the diseased tissue of its quota of Calcium. Its use ought to be limited to haemorrhagic and other conditions where Blood Calcium has to be raised and the tissue Calcium is of no moment. Practically however Parathyroid Extract is nearly always used in the treatment of tuberculous conditions and there seems to be some clinical evidence of its value in P. P. after prolonged administration. Administration of Pancreatic Extracts reputed to enhance the intestinal absorption of Calcium specially when digestive disturbances make the assimilation of Calcium difficult, was almost a

routine procedure in these cases. In the dyspeptic cases it was found useful and it seemed to make oral Calcium therapy definitely more satisfactory.

(*b*) Injections : Calcium Chloride in different strengths was used and from the unsuitability of Calcium in cases with a high temperature it was decided to give it in this type of case (where it was not absolutely contraindicated) in only 1% or 2 to 5% of cases and in small doses of 1 c.c., 2 c.c. and so on while in the more suitable cases 10% 5 c.c. was often used.

Colloidal preparation of Calcium has been very much criticised as being neither colloidal nor Calcium. The result in many of these where this was the only preparation used was quite satisfactory and does not agree with these criticisms. As a matter of fact after 2 c.c. injections twice daily, all the bad effects of an overdose of Calcium were obtained proving that it certainly is Calcium whether it is Colloidial or not. The general dose used was 1 c.c. thrice weekly.

In a small but definite percentage (about 12%) of cases generally in the earlier cases combined treatment of oral administration and injection of Calcium was found to definitely arrest the progress of the disease and render the case afebrile. Many of them are still under observation and it is difficult to say how many can be considered really cured yet.

Iodine : Was tried in 3% of cases, mostly P. P. cases originating in pleurisy and in the extensive fibrotic chronic type. The colloidal preparations were used as also an Italian preparation which contained Iodine among other things. It was used with a great deal of caution but nothing untoward happened and in at least one and probably two cases the Iodine was found to be helpful in reducing temperature and inproving the weight.

Gold : a heavy metal is far more likely to damage the tissues of an enfeebled patient than a drug like Iodine and in view of what has been written above about the susceptibility and vulnerability of Indian patients to T. B. it is essential to use Gold very cautiously indeed. My experience is confined to three preparations in the market of these one is probably a double thiosulphate of Gold and Sodium and has given brilliant results in at least one case with large cavities in both lungs but I have not been encouraged to proceed with further trials in view of the possibility of reactions. My experience of another product reputed to be the mildest is also limited. I shall practically confine my remarks to the results with a German preparation which can be given intramuscularly and of which I have a fairly large experience.

In this series 35 cases were tried with this particular Gold preparation. In at least 4 cases with extensive cavitation and temperature ranging from 98° to 101° and 102°, the results have been good indeed, the fever left after 4 to 11 injections and there has been continued steady improvement all round where none could be expected in the ordinary course. Nine cases showed marked improvement with disappearance of bacilli but the fever has not disappeared altogether yet. In six cases the injections were not followed up ; in 16 the results were doubtful or negative. The doses were in every case extremely small being 1/10 of the first dose advised by the manufacturers and the doses were then gradually increased very slowly : also the interval allowed between each injection was generally between 4 to 6 clear days. With one exception only, in all these cases treated, there was not one unfavourable reaction noted. In the only case which gave an unfavourable reaction the dose administered was by mistake the same as advised by the manufacturers and not as I generally give. The unfavourable reaction was a definite focal reaction with appearance of much moist crepitation which took a few days and an injection of Calcium Chloride to disappear.

Soda Morrhuate : It was only used in 2 of these cases. Both these cases happened to be bad pulmonary ones and did not respond favourably to the drugs in any way.

Artificial Pneumothorax : As an illustration of peculiar condition prevailing in India specially

as regards tuberculosis we may cite the results of A. P. treatment in P. P. In this series 32 cases were treated by regular or partial treatment with A. P. These 32 cases include 8 cases in which A. P. was performed at Madanapalle, 2 at Dharampur and one at Itki. The 21 cases that were done here were done by the best men available in Calcutta. Out of all these 32 cases I can only claim 6 cases as having done wholly or partially well. Two of these favourable cases again were pleurisy with effusion running a continued temperature for 6 weeks and in these cases gas introduced after withdrawing the fluid. In the cases after repeated A. P. the temperature disappeared and improved sufficiently after the A. P. to be claimed as an improvement. Of the other four which undoubtedly got some benefit in one case phrenic evulsion was done and in another thoracoplasty was also performed in addition.

Nothing can illustrate the difference in virulence of our Indian cases from European cases than this poverty of results with A. P. Although the procedure is considered so safe that the whole outlook in tuberculosis is supposed to have been changed after its discovery and although large cavities yield after rest and A. P. in a few months, such is unfortunately never the case in India. It was only the comparatively slow type of cases with no temperature at all which proved satisfactory for A. P. treatment. In 2 cases with diabetes this treatment was attempted with very unfavourable results.

Choline derivatives: Theoretically speaking, preparations intended to raise the tension and produce conditions approximating to urbanisation in the individual, ought to favour the development of immunity. Practically however the preparations at present available in the market tend to produce severe reactions which make them generally unsuitable. They were tried in 3 cases with negative results.

Change of climate: In view of the greater vulnerability of our cases, a change of climate is more a necessity here than in Europe. About the merits of different sanatoria visited by our tuberculous cases the rainfall or the thermometer do not appear to serve as satisfactory guides. Results ought to give us a better indication but it is of course difficult to assess results from a bare enumeration of cases, the patients are also so different in type, the treatment they are subjected to and the discipline they accept at these stations so variable that nothing very much can be deduced from the figures given below. We note the results, however, for whatever they may be worth.

	Cases sent	*Improved*
Sonthal Parganas	38	12
Ranchi & Hazaribagh	9	2
Dehri-on-Sone	1	0
Bindhyachal	2	1
Allahabad	1	0
Benares	6	1
Dharampur	4	2
Almora	4	1
Puri	5	0
Waltair	1	1
Boating in big rivers in East Bengal	2	1
Boating in Jumna at Allahabad	2	1
Darjeeling	1	0
Shillong	4	2

SUMMARY:

In this paper attention has been drawn to the stage of tuberculisation in this country and consequent susceptibility and vulnerability of the cases. Prophylactic measures are suggested on the basis of this theory. A resume of results with different therapeutic measures is given.

The Value of Modern Sanatorium Treatment in Advanced Pulmonary Tuberculosis as shown by the Disappearance of Tubercle Bacilli from the Sputum

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It is a prevalent opinion even among medical men that 'Sanatorium Treatment' for pulmonary tuberculosis is of use only for early cases. Even at the present day there are sanatoria which refuse admission to advanced cases, but the modern methods of sanatorium treatment have revealed the fact that even in many of the most desperate cases some very striking results can be obtained, and the admission of advanced cases of pulmonary tuberculosis into sanatoria has, therefore, steadily increased during the last 20 to 30 years.

This may be illustrated in India by the admission figure of the Union Mission Tuberculosis Sanatorium, Arogyavaram. In the years 1916 to 1920, only 24 per cent. of the admitted cases were in the advanced stage: whereas during the years 1921-1930 there were more than 53 per cent. The increase in the number of admissions of advanced cases coincides with the introduction of Artificial Pneumothorax treatment in the Sanatorium and later additional treatments as Sanocrysin and Phrenic-exairesis. The immediate results of treatment at the time of discharge have in the last years improved at Arogyavaram, particularly in the advanced cases. During 1915 to 1920, 24·7 per cent. of the patients in III stage were discharged as 'clinically well' while those discharged in the same way during 1926-1930 were not less than 34·3 per cent. The improved immediate results have been followed by a corresponding improvement in the after-results. * Of these patients in III stage, discharged as 'clinically well' during the period 1921 to 1925, 57·8 per cent. were living and nearly all doing full work 5 years after discharge in each individual case, as compared with 35·5 per cent. in the earlier period, 1916 to 1920.

The present investigation is to find out whether the improvements in the results mentioned above, show a corresponding improvement in the advanced cases as judged by the disappearance of tubercle bacilli from the sputum, and if so, how far the additional methods of treatment mentioned above have influenced this.

One of the important criteria for judging the effectiveness of any particular method of treatment in pulmonary tuberculosis is the disappearance of tubercle bacilli from the sputum. Both from the point of view of the prognosis of the individual case and in the interest of the prevention of the spread of the disease, it should be one of our main aims in the treatment of the disease to stop the excretion of bacilli from the sputum.

During the period 1920-1931, 1613 patients with tubercle bacilli in the sputum were treated at Arogyavaram. Of these 554 or 34·3 per cent. were discharged bacilli-free, as shown in Table I. (See page 286).

This table shows also the same cases in 2 years periods, grouped according to stages of the disease with reference to the disappearance of tubercle bacilli. During 1920-1921, there were no methods of treatment additional to the 'Sanatorium routine treatment', and therefore taking the figures for this period as a standard for comparison it will be seen that the most marked improvement has occurred in III stage. If stages I and II are taken together during the period 1930-1931 there has been an improvement of 33·8 per cent. over 1920-1921 period, while

* C. Frimodt-Moller, 'An Investigation of After-Histories of Sanatorium Patients in India', *'The Indian Medical Gazette'*, Vol. LXVI. (No. 9, Sept., 1931.)

TABLE I.

Patients Grouped according to Stages in 2 Years Groups with Reference to Disappearance of Tubercle Bacilli.

2 Years Groups.	I Stage.				II Stage.				III Stage.				Total of all Stages.			
	+ T. B. on Admission.	+ T. B. on Discharge.	- T. B. on Discharge.	- T. B. Percent on Discharge.	+ T. B. on Admission.	+ T. B. on Discharge.	- T. B. on Discharge.	- T. B. Percent on Discharge.	+ T. B. on Admission.	+ T. B. on Discharge.	- T. B. on Discharge.	- T. B. Percent on Discharge.	+ T. B. on Admission.	+ T. B. on Discharge.	- T. B. on Discharge.	- T. B. Percent on Discharge.
1920—21 ...	6	...	6	100·0	105	54	51	48·5	145	134	11	7·6	256	188	68	26·5
1922—23 ...	7	2	5	71·4	23	5	18	78·3	181	153	28	15·4	211	160	51	24·2
1924—25 ...	7	1	6	85·7	13	7	6	46·2	141	113	28	19·9	161	121	40	24·8
1926—27 ...	21	1	20	95·2	69	25	44	63·8	198	144	54	27·2	288	170	118	41·0
1928—29 ...	19	7	12	63·2	37	14	23	62·2	256	185	71	27·7	312	206	106	33·9
1930—31 ...	12	...	12	100·0	54	20	34	62·9	319	194	125	39·1	385	214	171	44·4
TOTALS ...	72	11	61	84·7	301	125	176	58·4	1240	923	317	25·6	1613	1059	554	34·3

TABLE II.

Advanced (III Stage) Cases divided in 2 Groups according to Treatment.

2 Years Groups.	III Stage cases treated with Sanatorium Routine Treatment alone.			III Stage cases treated with Pneumothorax, Phrenic-exairesis, Sanocrysin etc. in addition.		
	+ T. B. on Admission.	- T. B. on Discharge.	Percent - T. B. on Discharge.	+ T. B. on Admission.	- T. B. on Discharge.	Percent - T. B. on Discharge.
1920—21 ..	145	11	7·6	...	...	...
1922—23 ...	150	17	11·3	31	11	35·8
1924—25 ...	128	24	18·7	13	4	30·8
1926—27 ...	129	29	22·4	69	25	36·2
1928—29 ...	148	21	14·8	108	50	46·3
1930—31 ...	104	14	13·4	215	111	51·6
TOTALS ...	804	116	14·4	436	201	46·1

in III stage the corresponding improvement has been 414·0 per cent. What factors have contributed to this great improvement? Sanatorium routine treatment was the constant basic factor in all cases, but in addition to this the modern methods of additional treatment, described above, have been used since 1921. These methods have chiefly been adopted in III stage cases whereas nearly all I and II stage cases have been treated to a large extent along ordinary sanatorium lines.

In Table II is shown III stage cases treated by the Sanatorium routine treatment alone, compared with those treated in the same stage with additional remedies also.

It will be seen from the table that out of the 804 cases in the first group who had tubercle bacilli in the sputum, 116 or 14·4 per cent only were discharged as T. B. negative. In the different year groups the percentage of cases in which tubercle bacilli disappeared is small and there has been no appreciable improvement in the later years, because more and more in this group there tends to be left only those who cannot receive any of the additional methods of treatment on account of their disease being too advanced.

In contrast with this in the second group of III stage cases, those treated with additional methods, out of 436 cases 201 or 46·1 per cent. were discharged bacilli-free. The percentage of cases rendered bacilli-free has been comparatively high all through and there is a marked improvement in the later year groups, 1930-1931 group showing a percentage of 51·6.

An investigation of almost the same kind as that described above carried out by the writer in one of the best known European Sanatoria * showed very similar findings, a fact of considerable interest.

CONCLUSIONS :

1. It is only possible to discharge bacilli-free, a small proportion of cases in III stage by the Sanatorium routine treatment alone. In a large number of these cases the modern additional methods of treatment are necessary, and when these methods are adopted, the number of cases discharged bacilli-free is considerably higher : in this investigation 46·1 per cent. as against 14·4 per cent.

2. The improvement in later years in the figures of Arogyavaram as shown by the immediate results on discharge and by the after-histories of the patients is confirmed by a corresponding improvement as judged by the disappearance of tubercle bacilli from the sputum of patients in the advanced stage. This is largely due to the modern additional methods of treatment adopted in later years.

3. The above conclusions justify the admission of many advanced cases to a Sanatorium where the most modern methods of treatment are available and can be used in those particular cases.

* P. V. BENJAMIN : "The Value of Various Methods of Treatment with Regard to the Disappearance of the Tubercle Bacillus from the Sputum", *'Tubercle'*, January, 1932.

Artificial Pneumothorax in the Treatment of Dry Pleurisy

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According to BACNEISTER every case of pleurisy dry or with effusion is the result of another disease. The so called primary idiopathic pleurisy in which the pleura is only locally and primarily involved does not really exist and even if it does it is very very rare. The primary disease from which the pleura is involved does not necessarily lie in the lungs—the focus of infection may be a rheumatic joint or a heart with endocarditis or a septic and inflammatory focus lying in any part of the body. Most commonly it is secondary to an inflammatory process in the lung. Pleurisy is no doubt a common complication of pulmonary tuberculosis.

The cases where the primary disease is not detected and which were formerly called the primary idiopathic pleurisy have been found to be mostly tuberculous by careful examination. STINZING and GROBER found 50% of these cases tuberculous, while LANDOUZY, NETTER and ASCHOFF found 80—98% of them tuberculous. ALLARD made a long and laborious observation in

200 cases of idiopathic pleurisy 44·5% of which were later in the next 16 years found to be suffering from pulmonary tuberculosis and 20·5% were suspected to be tuberculous.

In the next six years another 18% were found to have manifested tuberculosis. Among the rest those who have died of other diseases might have latent tuberculosis and those who have been living healthy may have healed up tuberculous foci. Another noteworthy point was 27% of the children who had pleurisy between age 1 and 15 developed sure tuberculosis, while 54% of the adults who had pleurisy between age 16 and 50 developed well-manifested pulmonary tuberculosis. From this one can conclude that the so called idiopathic pleurisy occuring in adults of 16 and 50 years of age should be treated as tuberculous, even if the primary focus be not detected as it may manifest later in life.

In plastic inflammation the first thing that happens is hyperaemia followed by loss of natural polish of endothelial surface. The cells of endothelium become swollen and granular and multiply rapidly and many cells injured by irritants are cast off. Leucocytes infiltrate subendothelial tissues, some escaping on the actual surface accompanied by exudation of fibrinous lymph. As the inflammation subsides, the hyperaemia diminishes and more or less adhesion takes place between the roughened surfaces. Connective tissue cells multiply and shoot processes into the layer of fibrin which is gradually absorbed, new vessels are connected in this connecting mass and complete union by fibrinous tissue thus takes place. Owing to the movement of the opposing surfaces newly formed fibrous connections are pulled out into threads or bands of varying thickness. According to WEIL 85% of pleurisy cases are tuberculous and 82% of them develop permanent adhesion as aforesaid.

So the rational treatment of these cases would be not only to alleviate the local symptoms and the symptoms due to the local lesion in the pleura but to treat the primary focus if detected—if not to provide possible facilities for its treatment in case of future manifestation.

As it has been shown that the majority of the pleurisy cases in adults are either associated with pulmonary tuberculosis or later manifest the same and as artificial pneumothorax has proved to be one of the best—if not the best weapon to fight pulmonary tuberculosis and as adhesion is one of the worst hindrances in performing successful artificial pneumothorax, why should not we prevent adhesion of the pleurae (which is such a common sequel of this disease) by inducing A. P. in these cases of dry pleurisy ? With this idea I performed artificial pneumothorax in a series of 25 cases of dry pleurisy 60% of whom were male and 40% female. All of them were grown up adults of 16—40 years of age.

5 cases of the series were of bilateral pleurisy. In one case it was associated with bilateral pulmonary tuberculosis in the second stage. Partial pneumothorax was made on both sides. The patient improved clinically, pain disappeared totally, the temperature gradually came down below 99° F, expectoration and cough were less. At this stage he discontinued the treatment, went to his native village at Murshidabad and reported further improved after 4 months, but has not reported for the last 8 months and no further detail is known about him. In the other 4 cases no primary foci could be detected ; bilateral pneumothorax were performed refilling the pleural cavities alternately. The average number of refills required was six on each side and the average duration of treatment was twelve weeks. All these cases improved satisfactorily and have been O. K. uptil now, two of them were treated about 4 years ago.

36% of the series were associated with pulmonary tuberculosis 20% being in the same sided lung, 16% in the contralateral lung. In one case there was bilateral pleurisy with bilateral pulmonary lesion as already referred. In 4 cases where the same sided lung was affected complete collapse was made. Refills were continued for the benefit of pulmonary lesions till they were arrested clinically and radiographically necessitating an average of 32 refills. In 3 among them the pulmonary lesions were of exudative type varying from the stage of infiltration to

that of consolidation. The extent of the diseased area was considerable in 2 cases, and in the third it was only a patch of infiltration of about 3" in diameter. One of them has been working for the last 2 years without any trouble, the second has been fit for the last one year, but does not work, but takes a lot of exercise. The third has been fit for the last six months and has been walking all this time 4—6 miles a day. In the fourth case the pulmonary lesion was in the third stage with a cavity of 2" in diameter and extensive crepitations in the same lung, running a high temperature. (maximum being 103° F.) The patient was being treated with BRUSCHETTINI'S Antipyogenic (antituberculous) vaccine to no effect. He developed acute pleurisy associated with severe pain when I was called in. I started artificial pneumothorax—he was immediately relieved of the pain, the temperature came down a little, but persisted till the lung was completely collapsed. He had altogether 34 refills, discontinued the treatment against advice. He has got no temperature, no cough or expectoration. can stand moderate exercise, but is not yet fit for hard exercise or work.

Four cases of the series came for the treatment of pulmonary tuberculosis and during the course of treatment dry pleurisy became evident in the contralateral side. Three among them were already being treated with artificial pneumothorax and one with Solganal B. In the former three cases air was partially withdrawn from the pleural cavity to let the collapsed lung expand partially, and a partial collapse was induced on the other side. Thus partial bilateral pneumothorax was maintained in these cases for about 3 months on average, with alternate refills and with an average number of eight refills in the pleuritic side in each case. In the fourth case who was being treated with Solganal B. a partial collapse was induced on the pleuritic side keeping the parietal and visceral pleuræ separated especially in the diseased part for about 2 months. The result was quite satisfactory as regards the dry pleurisy especially as regards the pain and the temperature that came in with the onset of pleurisy. It did not affect the primarily diseased lung in any way excepting the fact that the rate of improvement of the diseased lung which was fully collapsed was comparatively retarded due to partial withdrawal of collapse, but in no way hampered the final result. In one of these cases a course of chronic pleurisy due to the irritation of the air introduced ran for some time necessitating 14 refills on the same side alone, but it subsided gradually and showed no evidence of adhesion in the last refill which was induced after an interval of about a month and after a fortnight since the air was totally exhausted.

In 64% of the series no primary focus could be detected. In these cases the lung was collapsed to such an extent as to prevent the pleurae over the diseased area to come in contact with each other during inspiration and this much of collapse was maintained by refills necessitating on an average seven refills. The interval between the refills was also judged by the feeling of the patient *i.e.* when the patient felt sensation of rubbing. All these cases improved remarkably without any complication. The duration of the treatment was ten weeks on average. Two among them later manifested pulmonary tuberculosis in the same lung over which they had pleurisy before and were treated with artificial pneumothorax. The pulmonary lesions appeared in one case six months after the treatment of dry pleurisy and in the other nine months after. Both of them were again treated with artificial pneumothorax. Fortunately, no adhesion was met with proving my contention that it really prevents adhesion.

As regards the signs and symptoms, physical signs were present in all the cases. Physical signs, of course, disappeared after each refill, but reappeared with diminishing intensity with the absorption of the introduced air. So refills were continued till they totally and permanently disappeared. They disappeared permanently after 5 refills on average.

There was fever in 96% of the cases, though in pure pleurisy cases the average maximum temperature was within 100 degree F. and the

maximum temperature came below 99 degree F. after 2 refills on average in unilateral cases and after six refills in bilateral ones. Of course, in the cases associated with pulmonary lesion the temperature depended on the condition of the lungs as well and it is beyond the discussion of this paper.

Pain of varying intensity was present in 92%, it was extreme and unbearable in 24%, moderately severe in 40%, but bearable in 28%. In 8% of these cases the pain was comparatively unimportant. In all these cases pain immediately disappeared after the induction of artificial pneumothorax. The patient rolling in agony was asked if any pain could be felt : the patient smiled and answered in the negative. So, A. P. is unquestionably indicated in cases with severe pain.

Pleural shock was not much in evidence in unilateral cases. In bilateral cases when the second lung was collapsed for the first time there was pleural shock which was easily kept in abeyance by previous injection of morphia and atropine.

In unilateral cases of pure pleurisy the patient could resume his normal duties after the third or fourth refill, while in bilateral cases they could resume duties after eight refills on average.

The only possible argument against performing A. P. in these cases is that it may be complicated with effusion or that a chronic pleurisy may set in due to the irritation of the air or nitrogen introduced. Fortunately, effusion due to artificial pneumothorax is not so common in our country as in Europe. In this series no effusion that could draw the clinical attention was observed. In my series of 25 cases only in one case such chronic pleurisy due to the irritation of the air introduced persisted, thus necessitating 14 refills—consequently a longer course of treatment. But even if these hindrances unfortunately come in, it does not spoil the final benefit except the course of the treatment being prolonged than usual. Sometimes, one argues that an adhesion may be unknowingly present and in that case there may be some risk in causing the rupture of adhesion and the consequent rupture of the blood vessels grown inside the adhesion due to the introduction of air or nitrogen into the pleural cavity. This fear is entirely groundless—firstly because when the blood vessels grow inside the connecting bands they are too strong to be separated by the mere pressure of air, secondly refilling may be discontinued on detection of the adhesion, thirdly in performing A. P. one should always avoid the region of lesion, select a suitable spot where the pleura seems to be quite healthy thus avoid unnecessary disturbance of the adherent zone, if there be any.

Artificial pneumothorax in the treatment of dry pleurisy is justified for the following reasons :

1. It prevents the friction of the two inflamed pleuræ, thus helps to bring down the inflammation quickly by avoiding constant irritation due to friction.

2. It relieves the pain instantaneously, however severe it may be. So it is unquestionably indicated in cases of severe pain.

3. It prevents adhesion, so

   (*a*) it prevents any impairment of the normal function of the lung due to adhesion

   (*b*) it provides proper facilities for performing A. P. if it becomes necessary in case of future manifestation of the disease in the lung of the same side.

4. When associated with lesion in the same sided lung it helps in the healing of pulmonary lesion as well.

5. It cuts short the duration of the disease. As shown already the patient can resume his duties early, and continue his refills as necessary while working.

From these observations one is tempted to conclude that recent dry pleurisy where no adhesion is formed is a proper and suitable indication for artificial pneumothorax. This paper, however, from its limited data does not venture to declare any definite conclusion, but invites the colleagues in the line in this country to investigate if they could confirm my contention in this paper.*

LITERATURE

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2. BACMEISTER : Lehrbuch. der Lungenkrankheiten.

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*Paper read at the Scientific Section of the VIII All India Medical Conference held in Calcutta March 1932.

Heliotherapy in Tuberculosis and its Problems in India

By DR. PANCHANAN BOSE, M. B., (Cal.) M. D., (Berlin.)

Sun worship has been prevalent in India from the early Vedic times. Exposing the bare body of newborn babies and infants after application of mustard oil to the skin is quite a popular practice even at present in many Indian homes. The ancient Egyptians, Greeks and Romans used to adore the Sun god as the dispenser of health and vital force. Sunbath was largely employed by the Romans in order to build up a strong physique. The Greek physician, HIPPOCRATES and the Arab doctor, AVICENNA advocated the use of sun's rays for the cure of many diseases and maintenance of health and avoidance of sickness.

It is only in the beginning of the nineteenth century that actual indications for sun-cure in diseased conditions have been more or less defined and the credit of extending the application of heliotherapy to tuberculous arthritis belongs to the Lyons School of Medicine (OLLIER and PONCET). The Viennese doctors advocated in the early eighties of the last century the exposure of scrofulous children to the sun's rays. It was the great Danish doctor, FINSEN who made the first critical and scientific study of the healing properties of the various portions of the solar spectrum and it was he who inaugurated the treatment of small-pox by means of red light and that of lupus vulgaris by ultra-violet rays.

Treatment of badly healing ulcers by sun's rays was first reported by BERNHARD, a Swiss surgeon practising in Upper Engadine on the Alps. But BERNHARD and the Lyons School had so far advocated local sun-cure on the diseased part only. The famous Swiss surgeon, ROLLIER, who started heliotherapy since 1903, however, employed general sunbath combined with local insolation. His idea is to fortify the body in general, so that the bacilli of tuberculosis won't find it favourable to develop and spread in the body at all. Once the general resistance of the body is increased by heliotherapy, the system can deal with the local disease by itself. This marked a new epoch in the treatment of tuberculosis in general. Due to ROLLIER'S imagination, genius and organising capacity have sprung up the small Alpine village, Leysin at 4200 ft altitude in the Canton Vaud, the thirty-eight modern sun-clinics and the unique International Factory clinic for the treatment of some 1300 tuberculous patients, suffering mostly from some form of external tuberculosis. The brilliant results of ROLLIER by sun treatment in the so-called surgical tuberculosis have stimulated world-wide interest in this method of conservative treatment and even the best known interventionist surgeons have been convinced of the efficacy of heliotherapy in those forms of tuberculosis, where surgical operations were too commonly undertaken. The replacement of the knife by the sun's rays have improved the prognosis in tuberculous bone and joint diseases to such an extent that the poor patients affected with these diseases are no longer doomed to chronic invalidism with loss of function in the affected limbs but they can now be returned into the society as useful members capable of earning their own livelihood, in as much as, heliotherapy restores the functional activity of diseased joints to a remarkable extent. Hence heliotherapy has been rightly called the highest art in conservative orthopedic surgery.

BIOLOGICAL AND THERAPEUTIC ACTION OF SUNLIGHT

The action of sunlight on the human body may be considered under the following heads :

I. General
  (*a*) On the skin
  (*b*) On the muscles and bones
  (*c*) On the blood
  (*d*) On metabolism
II. Local
III. On the mind

I (a). *On the Skin*

In heliotherapy the skin is exposed to the solar radiations as well as to the atmospheric

air and whatever effect is produced in the body is due to the double action of the sun's rays and the air. The skin has got various functions, namely, protective, eliminative, thermo-regulatory, sensory, metabolic, hormonal and anti-toxic. In order to function properly the skin must be restored to its normal milieu, *i. e.* it should come in contact with air and sunlight. A large quantity of blood cirulates through the skin capillaries which may contain as much as 18% of the total volume of blood. As a result of a sunbath all the skin capillaries dilate and this vaso-dilatation relieves the congestion of the internal organs and produces a fall in the arterial blood pressure.

There is elimination through the hyperaemic skin of a good deal of sweat and sebaceous secretion. Desquamation of the superficial layers of the epidermis is also another form of elimination. The constant touch with cool atmospheric air and at the same time with the heat rays of the sun produces a pleasurable sensation and prevents overheating of the body. In hydrotherapy, alternate cold and hot douche is used to strengthen the nervous system. In heliotherapy, similarly, the warm sunshine and the cool atmospheric air playing simultaneously on the skin, which is supplied with numerous sensory terminals, exert a tonic action on the nervous system. The cutaneous stimulation improves reflexly the function of the various internal organs in the thorax and abdomen, and provokes a vagotonic effect, as is evidenced by a sharp leucopenia and alkalosis of the blood after insolation.

The superficial layers of the skin are rich in lipoids and cholesterine and by the action of the actinic rays of the sun, the cholesterine is partially converted into Vitamin D, which plays such an important role in the body metabolism, specially with regard to the utilisation of calcium and phosphorus from food materials. Thus heliotherapy can actually replace Vitamin D therapy in Rickets and other diseases, like Tetany or Spasmophilia which are accompanied by misbalance of calcium and phosphorus in the blood. In tuberculosis of bones and joints which are accompanied by perifocal decalcification, heliotherapy aids the recalcification of the diseased bone, as is evidenced by radiographic controls. Sun bath has a stimulating influence on the general oxidative process of the body and HILL has noted 50 to 100% increase in the basal metabolism rate under the influence of sunlight. This explains the experience of DORNO who has found that the coefficient of cooling of the body surface exposed to the sun and the dry air of the mountains, even in winter, is less than the same which is observed in hot countries.

The hormonal and anti-toxic functions of the skin are evident from observations made in relation to disease. The skin is influenced by the menstrual cycle as well as by the secretion of the thyroid and the pituitary body. It can partially take up the function of the supra-renals, in deficiency of the adrenal bodies. The anti-toxic function of the skin is seen in those diseases where cutaneous eruption causes a diminution in the general toxic effect of the disease producing agent (as in most exanthemata). The modern practice of preventive inoculation by intradermal injection or by scarification demonstrate clearly how the skin plays an active part in the elaboration of immune bodies. It has been shown that tuberculin does not produce an inflammatory reaction in a skin which has become pigmented after exposure to sun's rays. A strongly positive VON PIRQUET'S reaction becomes gradually fainter, as the patient progresses towards cure of his illness under the influence of heliotherapy.

Pigmentation and Sun Cure—An interesting biological phenomenon observed after sun treatment is the increase of pigmentation. According to BRUNO BLOCH this pigmentation is due to the action of a ferment (called dopa-oxydase) on substances like 3, 4, Dioxyphenylalanin (called dopa) which are present in the basal cells of the epidermis. The ultraviolet rays of the solar spectrum activates the dopa oxydase and thus causes increase of pigmentation in the skin.

According to ROLLIER and ROSSELET this pigment plays an important function in heliotherapy.

FINSEN'S previous experiments have shown that the ultra-violet rays of the sun cannot penetrate deeply. They are lost in the superficial layers of the skin. ROLLIER has, however, observed the healing of deep-seated lesions after the skin has become pigmented from insolation and he naturally ascribes to these pigments the function of transformers, in the sense that the short waves of the spectrum are transformed into longer waves with greater penetrating power. DREYER'S success by the use of sun's rays poor in ultra-violets in Copenhagen, after sensitizing the patients with fluorescent substances like, Eosin or Erythiosine, makes it plausible that the pigment acts as transformer of energy like DREYER'S fluorescent substances. The discovery of RAMAN effect supports the hypothesis of ROLLIER and ROSSELET and the demonstration of this interesting physical phenomenon in the field of biology should engage the attention of future research workers.

It has yet to be carefully studied how the pigmented skin ef Indians behave under sunlight treatment. There is no doubt about the fact that even in a brown skin there is increase of pigmentation from exposure to sunlight and it is precisely to this increased pigmentation that ROLLIER ascribes important biological and curative properties. Once the skin has become pigmented there is less risk from untoward reactions and the process of cure goes on more-quickly when heliotherapy is continued on this hyper-pigmented skin.

I (b). *On the Muscles and Bones.*

General insolation of the body has a remarkable action on the subjacent muscles. Without any massage or electrical treatment, the muscles of patients who are completely immobilised in bed, as in cases of POTT'S disease or hip disease, develop in such an extra-ordinary manner that visitors to the sun-clinics at Leysin are all struck by the harmonious and almost athletic muscular development of tuberculous patients. This muscular development is due to two factors, firstly, due to passage through the muscles of a large volume of blood, as it is drawn from the interior to the skin and secondly, due to increased muscular tone as a result of cutaneous stimulation of the sensory terminations by solar radiation..

This muscular development is very important in surgical tuberculosis. It helps the return of function in tuberculous joints which have been immobilised for a long time. In case of spondylitis the well-developed back muscles serve as strong support for the weak vertebral column. The development of the thoracic muscles helps the movements of the thorax and thus contributes to increased ventilation and oxidation of the blood and improvement of the circulation in the abdominal viscera.

Sunlight favours the calcification of bones, as has been confirmed by the work of HESS and of HULDSCHINSKY in rickets by the use of ultra-violet rays.

I (c). *On the Blood.*

The number of red blood corpuscles and haemoglobin value of blood increase as a result of sun treatment. The differential count of the leucocytes becomes altered as the patient progresses towards recovery. The polymorphonuclears are diminished in number whereas the lymphocytes augment. The rarefied atmosphere of the mountains where sun treatment is usually practised, acts as a further stimulus to the hoemopoietic system and thus the combined action of the sun and mountain air effectively combats the anaemia, from which most tuberculous patients suffer. The anti-toxic power of the blood is also enhanced by heliotherapy as has been demonstrated by LEONARD HILL.

I (d). *On Metabolism.*

We have already discussed how sunlight affects the general metabolism by activating the functions of the skin. There is a marked dehydration of the tissues, due to increased sweat secretion and elimination through expired air, specially noticeable in plethoric individuals. In this respect sunlight has the same action as the salt-free diet of GERSON and SAUERBRUCH which is now so much in vogue for the treatment of tuberculosis in Germany. There is increased

oxidation, augmentation of basal metabolism rate, diminution of blood sugar with increased sugar tolerance (PINCUSSEN), increase of calcium and phosphorus content in blood (HESS), with modification of the acid base equilibrum tending towards alkalosis, which favours the recalcification of the bones or other diseased foci.

II. *Local Action.*

Locally sunlight has a marked analgesic action. The disappearance of pain with heliotherapy is well appreciated by the patients. If there is a superficial wound, the sun's rays can exert their bactericidal and cicatrising action on it. The hyperaemia which is produced locally helps the migration of phagocytes and the absorption of local oedemas and tuberculous infiltrations. There may be spontaneous elimination of sequestra or diseased caseous gland (glandular sequestrum.) The penetrating rays of the sun produce sclerosis and calcification of deep-seated foci.

III. *Psychical Effect.*

Last but not the least we should consider the effect of sun treatment on the mind of the patients. As the physical condition of the patients improve, the mental outlook undergoes rapid transformation. Patients who were in despair begin to recover their will to get cured. This kindling of optimism is a great factor in the healing of tuberculosis and sunlight treatment sustains this satisfactory attitude of the mind to a remarkable degree.

CLIMATE SUITABLE FOR HELIOTHERAPY.

In a hot country like India the first essential for practising heliotherapy is a climate where the temperature in shade remains cool practically throughout the year. The plains and sea coasts of India are much too hot for the practice of heliotherapy for at least nine months in the year. In December, January and February it is possible to do sure cure in the plains, provided one selects a place with a dry climate free from mists and smoke nuisance and provided there is no prevalence of strong chilly winds.

For the establishment of a sun-clinic, it is essential to select a hill station which will satisfy the following requirements :

(1) *Altitude*—between 4500 to 6000 ft.

(2) *Maximum temperature in summer* not exceeding 85°F. *minimum temperature in winter* not too low.

(3) *Dry sunny climate* with *moderate rainfall.*

(4) *Purity of atmosphere*—absence of dust, haze, smoke and mists, for these things absorb the ultra-violet radiations.

(5) *Absence of strong winds and storms*—because in a cool atmosphere, if there is wind, it causes too great chilling of the body surface, so that it is impossible to expose the bare body to the sun. Even in places where there is moderate wind, it is necessary to select a portion of the hill which is protected from winds. For this reason, a broad valley surrounded by hills on all sides seems to be a good site for a heliotherapeutic clinic.

(6) *Absence of flies, mosquitoes and other biting insects like "Pishu"*—This last condition is very important in a tropical country like India. The mosquitoes usually do not come out at day time. They may be avoided by the use of mosquito curtains at night. But flies are a great nuisance at day time, specially when there is bright sunshine. As the flies breed on filthy materials, it is dangerous to expose wounds to sunshine in a place where flies are numerous. Unless the general sanitation of the place be improved, with proper disposal of night soil and refuse materials and sewage water in general, there is no other way of combating fly nuisance. Flies are much too annoying for bed-ridden patients and as they interfere with the rest of tuberculous patients, it is very important to select a climate which does not favour the breeding of flies. The writer has enquired from various sources for such a suitable climate in the hill stations of India and so far he has not been able to find one which will satisfy all the above requirements. We should also mention that the place must be easily accessible, otherwise it will be too fatiguing and risky for tuberculous patients, specially those suffering from bone and joint disease to undertake the journey.

TEMPERATURE OF SUNBATH

This is a very important consideration in a hot country like India. ROLLIER writes in his book on Heliotherapy : "No hard and fast rule can be laid down as regards the right temperature of the sun bath which the patients can stand without making any complaints. For here, like everywhere else, individualization is indispensable, and both the general as well as the local reactions, and also the personal sensations of the patients, have to be duly considered and weighed. A strong person, well trained for the sun-cure, who is suffering from a closed lesion, giving rise to no general symptoms, is able to stand temperatures of anything between 10° and 40°C in the sun (even higher still in winter) with great ease. On the other hand a debilitated individual with infected wounds or one with internal complications, must avoid extremes of temperature, both high and low, especially at the commencement of the treatment, for they are apt to upset his tolerance and to call forth violent focal reactions. In this class of cases, therefore, the permissible range of temperature has to be reduced and kept in the neighbourhood of the normal body temperature.

"It is true that opinions differ concerning these temperatures. Some authors have tried to classify these baths into various groups. They hold, for instance, that up to 18°C we are dealing with cold air baths, and only above 18°C do the sun baths proper begin. If such a differentiation should be made at all, I would suggest the following reversion : baths up to 18°C (in the shade) to be named hot air baths.

"However, let us take it as a principle that the sunbath ought to create a sensation of comfort on the part of the patient and consequently it must be modified accordingly ; for one person will experience cold, when another will complain of heat at the same time."

As Indians are habituated to warm climate, they can easily stand a temperature higher than 18°C (in the shade), up to 24°C *i. e.* 75°F and still feel a sensation of comfort while undergoing sun treatment. Too high air and sun temperature will be fatiguing and depressing and hence the early morning sun is preferable for sun cure. It is safe to note the temperature of the air and the sun before starting sun cure in a new place and if the air temperature is relatively cool and the sun temperature sufficiently hot, then sun cure should be started.

TECHNIQUE AND DOSAGE.

It is best to start sun cure from the legs and then gradually proceed upwards according to the plan advocated by ROLLIER. The patient is first habituated to the mountain air while he is in perfect rest in bed. After a week or so when he can stay outdoor for several hours without feeling any lassitude, the feet are exposed to the sun's rays for 3×5 minutes with ten minutes interval in between. On the second day the legs are uncovered up to the knees and exposed for 3×5 minutes while the feet are exposed for 3×10 minutes. On the third day, exposure is extended to the thighs which receive the sun for 3×5 minutes, the legs receiving 3×10 minutes and the feet 3×15 minutes. In this way one goes on exposing up to the umbilicus, then finally the chest in a progressive manner. The insolation is continued till a maximum of 2 to 3 hours is reached in winter. In summer in a tropical country like India, it is prudent to limit the duration of insolation from $\frac{1}{2}$ to 1 hour.

Head and neck lesions are to be exposed to sun's rays only after the patient has become quite habituated to sun bath in front and on the back without producing any reactions. In pulmonary trouble great caution is necessary in exposing the thorax to the sun's rays and it should only be undertaken under strict medical supervision. It is always a safe plan to finish the day's sun cure with the feet. This draws the blood to the feet and prevents congestion of internal organs and this procedure should always be insisted where there is a simultaneous lung trouble. It should be mentioned that in ordering the dosage for sun bath the doctor should be guided by the reactions of the patient. They may be general or focal.

If there is abnormal rise of temperature

headache or migraine, insomnia, lassitude and loss of appetite or dyspnoea or tachycardia, either the sun cure is to be stopped for a day or two or the dosage curtailed. A rightly dosed sun cure should produce a sense of comfort in the patient.

As for the focal reactions, increase of pain or tenderness (as in tuberculous peritonitis or superficial bone or periosteal lesions), increase of swelling and fluctuation (as in diseases of ankle, knee or hip or in adenitis) call for diminution in the dosage or suspension of local heliotherapy for a few days, till the reactions subside. For full and detailed description of the dosage and technique of sun cure in various tuberculous affections the reader is referred to A. ROLLIER'S book on Heliotherapy (Oxford University Press) from which most of the informations are collected.

CLINICAL INDICATIONS.

All forms of tuberculosis of bones, joints, glands, peritoneum, urogenital organs, skin and mucous membranes can be successfully treated by the conservative treatment of heliotherapy.

Only in unilateral tuberculosis of the kidney does ROLLIER recommend nephrectomy, but even in those cases sun treatment, before and after operation, is advocated by ROLLIER. By improving the general health and resistance of the individual, before the operation for nephrectomy is undertaken, heliotherapy improves greatly the success of the operations and during the post-operative period it aids the cicatrisation of the wound and shortens the convalescence of the patient.

In tuberculous diseases of bones and joints, heliotherapy—general and local—is combined with such orthopaedic appliances of immobilisation (simply by means of cushions filled with millet seeds in POTT'S disease) that the greatest area of the skin can be exposed to the sun's rays. Heliotherapy prevents the atrophy and necrosis of the skin and wasting of muscles which are so frequently observed, when the old-fashioned immobilisation with plaster of paris bandages is employed. In fact the sun's rays by improving the circulation in the skin, muscles and ligaments effectively combat local and general atrophy due to inmobilisation, so that ankylosis is seldom observed in the closed cases of joint tuberculosis and hence the functional utility of the joint is preserved. The writer has seen many old-patients of PROF ROLLIER doing their usual avocations in Leysin and he remembers particularly a tailor who came in a moribund condition in Leysin with multiple foci in the vertebral column, knee joint, both wrists and the lungs and after being completely cured could carry on his work and earn his own living.

In tuberculous adenitis sun treatment reduces the swelling of the glands, leads to rapid cicatrisation and even to calcification in some cases. No ugly scars are formed, as in surgical treatment and fistulous cases heal with a smooth scar under sun cure. By heliotherapy the glands may even recover their previous function, whereas by the operative treatment, the removal of the glands destroys the very barriers which are put by nature in the path of the invading germ and hence relapse or aggravation of the disease is very common after operative treatment. By sun treatment, however, there is no chance of spreading of the disease or of any other complication.

In peritoneal and abdominal tuberculosis, heliotherapy has effectively replaced surgical treatment. The exudative and fibro-adhesive form of peritonitis respond well to cautious sun-treatment. Tuberculous tumours of the ileo-caecal region or of the adnexa in the females, also disappear with heliotherapy. It is only in the caseating types of abdominal tuberculosis with involvement of the bowel that failures are recorded with heliotherapy. In certain cases of caseating and fibro-caseating peritonitis the effect of sun cure may be increased by the application of X-rays, especially when the absorption of the nodular masses takes place very slowly.

In tuberculosis of the skin and mucous membranes heliotherapy gives satisfactory results. Tuberculosis of the larynx is benefited by the application of sun's rays on the mucous membrane through suitably placed reflectors. Tuberculous disease of the eyelids responds well to local sun-treatment. In lupus vulgaris general sun bath on the healthy skin with exposure of the diseased skin to diffuse sun light (not direct insolation)

has yielded quite good results in the hand of ROLLIER. Even at the Finsen Institute at Copenhagen local phototherapy confined with general insolation is advocated at the present moment, as this combined treatment gives better results than local treatment alone. FINSEN himself wrote "Let us not forget the advantage of high altitude when planning photo-therapeutic institutes or sanatoria for lupus cases. Quite apart from the economy effected by the substitutions of sunlight for electric light, one obtains better results at high altitudes than in the low country owing to the increased chemical power of the solar radiation."

So far as heliotherapy in *pulmonary tuberculosis* is concerned, it has to be carried out with great precaution and the cases suitable for heliotherapy have to be carefully selected. As a general rule it may be stated that heliotherapy is contra-indicated in all acute evolutive cases (pneumonic or bronchopneumonic type), in all febrile cases and all cases giving a history of recent haemoptysis. Only when the disease is of chronic cirrhotic type that cautious sun treatment can be undertaken. Chronic pleurisy, old standing pleural effusions and hilar trouble in children and young adults are suitable indications for general sun treatment according to ROLLIER. The sun cure has to start with the legs and finish with the legs and in this way it diminishes the congestion of the pulmonary circulation, which is so often present in all cases of chronic pulmonary phthisis. Direct insolations of the thorax should be undertaken very cautiously, as it may provoke haemoptysis and the formation of fresh lesions even in sluggish and afebrile cases. But when the dosage and techinque of insolation is carefully controlled, sun treatment causes a striking improvement in those cases of pulmonary tuberculosis which have been properly selected after a prolonged observation and study of the case.

AS A PROPHYLACTIC.

If sunlight can cure all forms of external tuberculosis and help the process of repair in many chronic cases of pulmonary tuberculosis, then how important it is to employ it for preventing the development of disease in pre-tuberculous children and adults. Prevention is better than cure and if we can extend the use of sun bath in the field of prophylaxis then we have really done something to combat the tuberculosis problem which has assumed such grave magnitude in India.

Children are often confined to ill-ventilated class rooms where sunlight cannot penetrate. In big cities, women are confined to dark apartments where fresh air and sunlight are rare commodities. It is no wonder that the death rate form tuberculosis among young Indian women is five times as great as amongst men of the same age period. School children and women require open spaces or parks where they can take physical exercise in open air and sunlight. Building laws in cities have to be strongly enforced ensuring maximum sunlight and ventilation in school rooms and dwelling houses. Delicate children and persons who have been exposed to the risks of infection can profit much by staying in preventoria situated in hill stations where, by a regulated life in pure air and sun shine combined with rest and adequate nourishment, they can improve their health and resistance to disease to such an extent that the germ of tuberculosis will not be able to produce its ravages in their fortified system. Schools in the hills, run on hygienic lines, will be of immense benefit to delicate children. There is a great need for suitable preventoria and sanatoria in India, if we have to really combat the menace of tuberculosis, and in planning future preventoria or sanatoria, adequate provision should be made for heliotherapy.

The Tuberculosis Problem Facing India to-day

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There is perhaps no other subject on which so much is talked about and so little known not only amongst the lay public but even amongst medical men as tuberculosis. Ever since the discovery of the tubercle bacillus by KOCH in 1882 a great deal has been said regarding its aetiology and pathology and numerous attempts made regarding prevention, not always in the right direction. In fact the very first result of the discovery has been the great degree of alarm created amongst all regarding its infectivity and the social odium in which the subject of tuberculosis has been and is still being held by his fellow brethren. One even feels that apart from the scientific value of the discovery of the organism by KOCH, the world has been no better regarding the knowledge of the prevention of tuberculosis, as the direct outcome of the discovery of the organism. All attempts made so far to apply our knowledge of the bacteriology of tuberculosis to its prevention by immunizing vaccines and sera have so far proved more or less perfectly futile or at best can be said still to be little experiments barely touching the fringe of the question. I do not wish to belittle the value of the B. C. G. vaccine of CALMETTE or the alleged specific value of SPAHLINGER's vaccines and sera or of BRUSCHETTINI's sero-vaccines, but even here one cannot honestly say that they have yet established themselves in their scientific place along with the other classical immunizing sera and vaccines with which modern bacteriology has been able to arm us.

There have been marked differences of opinion amongst persons who have had opportunities of making a special study of tuberculosis regarding the degree of infectivity of the tubercle bacillus and the part it plays in the production of the disease, especially in adults. The questions whether re-infection occurs in nature, whether heredity as such has any effect on the tissues making them particularly vulnerable or otherwise to attack by the bacillus of tuberculosis, whether the organism has a truly saprophytic existence in nature, whether the acid-fast organism as described by KOCH constitutes the whole life cycle of the organism or whether the Alpha, Beta and Gamma forms of FERRAN actually exist, whether the transmutation of the human into the bovine form and *vice versa* is possible in the body of the same individual or at least in a series of generations in successive individuals and whether, as considered by some, the tubercle bacillus is a saprophyte gaining entry into tissues already affected with tuberculosis are questions requiring further investigation and elucidation.

Is tuberculosis increasing in India? If so what are the factors that have led to its increase? Is there anything like racial immunity resulting from long existing infection? How can the spread of the disease be controlled? These are the questions that have to be answered before we can tackle the tuberculosis problem as it faces us today. We have heard a great deal about racial immunity resulting from continuity of infection prevailing amongst races; but why is it that India where tuberculosis has existed for centuries, if not for thousands of years, has not yet manifested any signs of decrease of mortality due to such racial immunity in its large population? Why is it that whilst tuberculosis is on the decrease in several countries of the West including America and Australia where tuberculosis infection apparently gained an entry during comparatively recent times, an ancient country like India where tuberculosis has existed for a very much longer period is still having its population decimated by the scourge? Pandemics of influenza have swept over continents and have subsided after apparently establishing a general anti-bacterial immunity amongst the populations affected. Plague has committed its ravages during the generation following its appearance

in India at the end of the last century and is now showing signs of subsidence either as a result of immunity amongst rats or amongst the human hosts; but tuberculosis has been going on with its ravages generation after generation and, if anything, is more prevalent today than it ever has been in the history of the country for several centuries. It is evident that one has to look for a factor other than infection and immunity in the tuberculosis problem. No doubt the great war did give some definite evidence of the virgin soil amongst certain races that had to go to the front, but the racial immunity or susceptibility exhibited during the war was a comparatively very minor factor in the incidence of and the mortality from tuberculosis that was noticed and the fact that on the conclusion of peace, conditions have apparently settled down to the pre-war level is again an indication that one has to look for a factor apart from infection.

Students of the epidemiology of tuberculosis will have been struck with the outstanding factor that is governing tuberculosis incidence in all countries today. The richer a country, the less the prevalence of tuberculosis and the poorer a country the greater the mortality and morbidity from tuberculosis. This cannot be a mere coincidence. It is now generally recognized that tuberculosis is a disease of nutrition. The larger the population and the less the national resources the greater must be the mortality from tuberculosis. It is no good trying to shirk the main point in the tuberculosis problem. One talks of infection, of the dangers of spitting, of defective notification, of the ignorance of the masses, of insanitation, of unhealthy social habits and the like. These no doubt have some bearing on the vulnerability of the nation especially to a disease like tuberculosis, but the main outstanding factor cannot be lost sight of, namely, the want of sufficient food and the miserably low nutrition amongst the masses due to very scanty resources. Propaganda work has been so much stressed, people are told a great deal about the bacillus of tuberculosis and the havoc it causes, about living bacilli flying in clouds from roads used for promiscuous spitting, about the ignorance amongst the masses on matters of personal hygiene, etc; but one fights shy of the real question—namely supposing spitting is prevented by law, and sanitation is enforced by every possible means in the power of the Government and of the local bodies, will the mortality from tuberculosis lessen appreciably as a consequence when the masses continue poor, half nourished or starving? The answer to this question is an emphatic "no". It is no sound reasoning to argue that education, knowledge, propaganda work, tuberculosis institutions like hospitals and sanatoria, child welfare and maternity movements etc, have resulted in the marked decrease of tuberculosis mortality in modern countries. It is perhaps more sound to argue that all these are sure indications of the general national prosperity prevailing in those countries, and of the better comforts and nutrition that the masses are able to command in these more prosperous countries, which no doubt happen to be the more advanced ones as well in civilization, enlightenment and general sanitation. Has a century of Western education in India decreased the mortality for tuberculosis? It has not: but it has on the other hand coincided with an increase of its ravages and India today is losing a million of its population annually from tuberculosis whilst it was probably losing less than half this number a century and more ago. The individual resource and the purchasing power of the individual have considerably decreased, on account of a steadily increasing population, much more costly living, much less of personal comfort, and possibly deterioration of foodstuffs due to modern machinery and the modern methods of living on artificial foods devoid of the vitamines of nature which our ancestors in their 'ignorance' were having in plenty in their simple village life. The town and city milk devoid of vitamines, the polished rice, the manufactured materials like biscuits and artificial foods bereft of the natural vitamines of the fresh grain, the teas, coffees and other delicacies appealing more to the taste than to the constitution have each and all played their part in lowering the national stamina.

with the result that a nutritional disease like tuberculosis has been marching along with fairly rapid strides, whilst the truly infectious germ diseases like cholera, small-pox etc., where modern science and sanitation and public health have come to our rescue have been showing a steady decline.

It can therefore be laid down as a formula that tuberculosis is a direct mathematical factor of national poverty, and of insufficient material resources, insufficient nutrition and insufficient physical stamina resulting from the national poverty. This factor may no doubt be slightly modified according to the general knowledge and eating habits of the various communities concerned, but these modifications are in considerable measure limited by material resources. There are many rich persons who do not know how to feed themselves but there are far more numerous poor people who cannot afford such perfect and healthy feeding. Whilst the disease works havoc both amongst the rich and the poor, it is now well recognized that it is pre-eminently a disease of the poor living in the slums.

It is thus becoming increasingly evident, as our knowledge of tuberculosis advances, that whilst knowledge, social habits, general sanitation and personal cleanliness have some slight value in tuberculosis prevention, by far the most important factor in the tuberculosis problem is the amount of national prosperity and resources on which alone a sound nutrition and a healthy constitution can be built and the soil for the propagation of tuberculosis sterilized. Birth control and late marriage, national development, industrial advancement, improved agriculture and better co-operative credit to help the poor ryot and the agriculturist, in fact all measures which help in increasing the prosperity of and affording better nourishment to the large population play a far more important part in tuberculosis prevention than compulsory notification, enforcement of rules against spitting and educational propaganda work against tuberculosis. National resources and national prosperity are the two main factors concerned in the problem of tuberculosis and it is the want of these that constitutes the problem that is facing India today. *

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A Report on Sanocrysin Treatment of Pulmonary Tuberculosis at Jadabpur Tuberculosis Hospital, Bengal

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The report covers a period from the middle of November, 1928 to the middle of February, 1932. The total number of cases treated is 32. The small number of patients is accounted for by the fact that prior to March, 1931, we could accommodate only a small number of patients as the new block was not ready for occupation.

Of the total number of cases treated, 14 received Sanocrysin alone, while the remaining 18 were treated with Sanocrysin combined with Artificial Pneumothorax. 220 injections were given altogether.

A brief summary of the early history of the drug will not be out of place. Sanocrysin, a double thiosulphate of gold and sodium, was introduced by MOELGAARD of Copenhagen in 1924 and has since then been extensively used for the treatmen tof pulmonary tuberculosis. MOELGAARD'S original theory was that it killed tubercle bacilli in our body and the severe reactions that usually follow an intravenous injection of Sanocrysin, were attributed to a large dose of endotoxin liberated from the body of dead bacilli. In view of this, an anti-toxic serum was prepared

and given before Sanocrysin was administered. But this serum proved to be of doubtful value in influencing the course of reactions and has therefore fallen into disuse. MOELGAARD'S original theory has not been corroborated by experimental results of subsequent observers. SWEANY and WASICK (1) for example tried the effect of Sanocrysin on tubercle bacilli and found that with recent strains of bacilli, some colonies grew in dilutions of one in twentythousand and that after tubercle bacilli had been exposed to Sanocrysin as strong as one in thousand in salt solutions and serum, they grew well in Petroff's medium ; and even after 60 days' exposure to 1 in 2000. Sanocrysin, the culture, when injected into guineapigs, produced tuberculosis. WRIGHT (2) went still further. He came to the conclusion that Sanocrysin 1 in 250 had no effect on tubercle bacilli in blood. From the above finding it is difficult to believe that Sanocrysin, in small doses that it is generally given, could have any bactericidal action *in vivo* ; nor could it explain the rapid disappearance of sputum and reduction in the number of bacilli that often follow even such small injections. The modern tendency is to regard the action of Sanocrysin as one of stimulation of the defensive mechanism of the organism. It possibly acts partly by stimulation of reticulo-endothelial system and thereby promoting rapid phagocytosis of the bacilli and partly by formation of new connective tissue. The shock produced by Sanocrysin is believed to be due to its poisonous action on the endothelium and not due to the liberation of endotoxin from the bacilli, and according to some authorities, the beneficial effects of Sanocrysin are due to this "shock" or allergic reaction.

In selecting cases for Sanocrysin the following indications were kept in view :

(1) Bilateral disease with moderate fever and much expectoration or unilateral disease where A. P. failed due to the presence of adhesions.

(2) In combination with A. P. in two groups of cases.

(*a*) In bilateral disease with only slight affection of one lung, Sanocrysin was combined with collapse therapy from the very beginning.

(*b*) In apparently unilateral cases where A. P. was the method of choice, but where with advancing collapse of one lung, there was evidence of spread of disease in the contralateral lung, Sanocrysin was combined with A. P. to check the progress of the disease.

(3) Where the patient apparently improved under other methods of treatment, but expectoration and the number of bacilli did not show any appreciable diminution.

(4) As a last resort in a few advanced cases where all the other mothods had failed.

DOSAGE.

The initial dose varied from 0·01 grm. to 0·05 grm. In uncomplicated cases the maximum dose reached was 0·75 grm. and this was repeated until the course of the disease was arrested and the sputum became negative. In two cases we exceeded this limit and went up to 0·85 grm. Both these injections were followed by untoward complications namely, albuminuria in one and severe focal reaction with spread of disease in the other. In case of severe reactions the same dose was repeated and a second injection was not given until all the reaction symptoms of the previous injection had completely subsided. The injections were given at intervals of about 10 days, the average interval in our series being 13 days. The average number of injections per patient was 6·9 and the average quantity of Sanocrysin per patient was 2·54 grms. The maximum quantity given to a patient was 7·8 grms.

In this connection, dosage recommended by two other observers may be compared. DR. STUB CHRISTENSEN in a recent article on Sanocrysin treatment has arranged his cases into two groups according to the dosage of Sanocrysin given.

Division I (with massive dose) in which an initial dose of 0·25 grms. to 0·5 grms. was employed, followed by doses of 1 grm. at an interval of 3 to 5 days up to a total amount of from 5 to 7 grms. 152 cases came under this series.

Division II. Those treated with modified dosage i. e., beginning with 0·05 grm. or 0·1 grm. and rising to but not exceeding 0·5 grm. and in some of the later cases not exceeding 0·3 grm. If no reactions occurred the intervals were 3 days between the first and second and 4 clear days between the subsequent injections. The total dosage in the great majority of cases was 4 to 5 grms. and in no case less than 2·5 grms. 232 cases were included in this series.

By comparing the results of these two divisions DR. STUB CHRISTENSEN has shown that those for Division II are by far the better, the percentage of cases in which bacilli disappeared from sputum being 70 for Division II as against 50 for Division I. The liability to serious complications is by far greater in Division I than in Division II as the following table will show :

Complications	*Division I. per cent.*	*Division II. per cent.*
Albuminuria	... 84	13
Intestinal Disease	... 43	3
Exanthema	... 39	10

BURREL (3) on the other hand is of opinion that small doses are practically useless and he gives 0·1 grm. for the initial dose followed in 3 days by 0·25 grm. and then at weekly intervals 0·5, 0·75 and 1 grm. The last dose is repeated 3 or 4 times. The course in his series lasted 6 to 7 weeks and consisted of 5·6 or 6·6 grms. of Sanocrysin.

It will thus be seen that BURREL more or less followed the method used in CHRISTENSEN'S Division I, but as BURREL'S opinion is based on 60 cases as against 384 of CHRISTENSEN'S, the latter's method of small dosage should ordinarily be the method of choice.

Both observers, however, lay stress upon not repeating the injection until every reaction of the previous injection had disappeared. In our series we adopted small dosage starting in very advanced cases with 0·01 grm. and this seemed to be justified by very severe reaction that followed even this small dose. Regarding the interval between injections we were rather overcautious, but it was also partly due to the fact that in our series, reactions in majority of cases lasted for a longer time.

PRELIMINARY PRECAUTIONS AND TECHNIQUE.

The urine of every patient was examined the day before, to be satisfied that it was free from albumin and sugar, especially albumin. Injections were given intravenously on an empty stomach. At first all the doses were dissolved in 20 c. c. of sterile distilled water; subsequently doses of 0·5 grm. and below, were dissolved in 10 c. c. and doses above 0·5 grm. in 20 c. c. of distilled water. This alteration did not seem to produce any change in the course of reactions and complications. An all-glass syringe was preferred to a Record syringe with metal parts, because, Sanocrysin combined with and formed a black coating on the surface of the metal with which it came into contact. For the same reason a platinum needle is more suitable than an ordinary needle. On one occasion, with a dose of 0·75 grm. the only suitable vein of the patient was missed and the whole of the drug dissolved in 15 c. c. of distilled water was injected intramuscularly in the gluteal region. Headache and fever came on within three hours and persisted for about 10 days. The part became inflamed and tender which rapidly subsided with fomentations but pain persisted for about two weeks.

REACTIONS AND COMPLICATIONS.

The following complications were observed in our series consisting of 220 injections.

(*a*) *Immediate Reactions*			*Per cent.*
Rigor in	100	or	45·5
Fever in	135	or	61·3
Headache	155	or	70·4
Nausea and Vomiting	9	or	4·1

These symptoms appeared within a few minutes to 3 hours of the injections, but fever and especially headache persisted for 3 to 4 days. It will be seen that these initial symptoms closely resembled those of shock, following a large dose of Tuberculin or a foreign protein.

Rigor set in abruptly and was often so severe in one case, that an attendant could only with much difficulty prevent the patient from falling from the bed. A few drops of Adrenalin Chloride solution (1 in 1000) under the tongue were tried in a number of cases and this certainly helped to check the intensity and duration of rigor.

Nausea and vomiting do not seem to be troublesome symptoms when injections are given on an empty stomach.

(b) *Delayed Reactions*			*Per cent.*
General Malaise	41	or	18·6
Anorexia and loss of appetite	30	or	13·6
Pain in the joints and limbs	23	or	10·4
Photophobia, burning of eyes and extremeties	8	or	3·6
Metallic taste in mouth	3	or	1·4
Pain in the abdomen followed by Diarrhoea	2	or	0·9
Dyspnoea	8	or	3·6
Haemoptysis	2	or	0·9

These symptoms generally appeared within 24 hours of the injection and persisted for 3 to 5 days rarely going beyond a week. As to how far these reactions are specific for gold it is difficult to say.

(c) *Remote Complications.*			*Per cent.*
Stomatitis	2	or	0·9
Albuminuria	2	or	0·9
Skin Eruptions	4	or	1·8
Sore Throat	2	or	0·9
Jaundice	1	or	0·45
Focal Reaction in lungs	8	or	3·6

These symptoms should now be considered in detail because some of them may be an indication for postponing or stopping gold treatment altogether.

Stomatitis. Stomatitis occurred in two cases —in one it appeared after a total amount of 1·6 grms. was administered, in association with dermatitis. The mucous membrane of the mouth cavity was sore and congested and ulcers appeared on the lower lip. An astringent alkaline mouth wash was all that was necessary. In the second case with extesive exudative lesions of one lung and half of another, Sanocrysin was combined with A. P. and stomatitis appeared after 0·6 grm. was given. The buccal epithelium became slightly congested and then denuded in places and the lips assumed a bluish grey hue. Sanocrysin was stopped ; astringent mouth wash and two injections of sodium thiosulphate (0·45 grm. each) cured the condition.

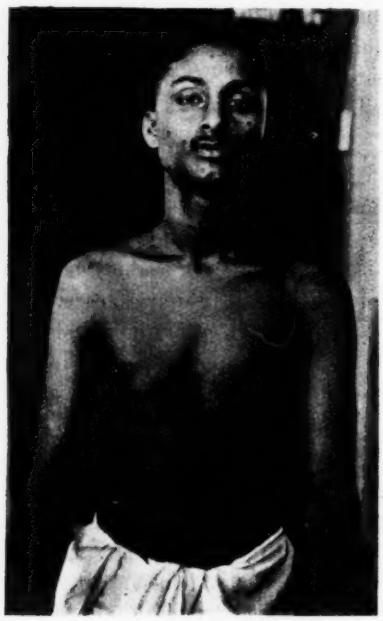
Albuminuria. Transient albuminuria described by other observers was not present in our series. The great majority of cases showed an excess of phosphates. As a routine measure we examined the urine on the day of injection and on the day following. In one of the two cases, albumin appeared after the last dose of 0·85 grm. when a total quantity of 3·5 grms. had been given. It was present in urine for 23 days following the injection and was associated with a rise of temperature (about 1 degree F.). When albuminuria subsided, the patient developed dermatitis. 7½ months after this attack the patient was given a course of Solganal B, but this time he had no further trouble. In the second case albumin appeared after a total of 4·7 grms. had been administered and persisted for a little over three months. During this period, the patient was treated with Tuberculin which he tolerated quite well.

Skin Eruptions. Occurred in 4 cases. In the first case (G.C.D.) it appeared after a total of 1·55 grms. A few black spots came out on both forearms with considerable itching, but as the patient used to suffer from scabies very frequently he did not bring it to our notice. The next injection of 0·4 grm. was given and it was after this that the spots appeared on the trunk and extremeties and the condition was brought to our notice. An additional dose of 0·4 grm. was given without any ill effects.

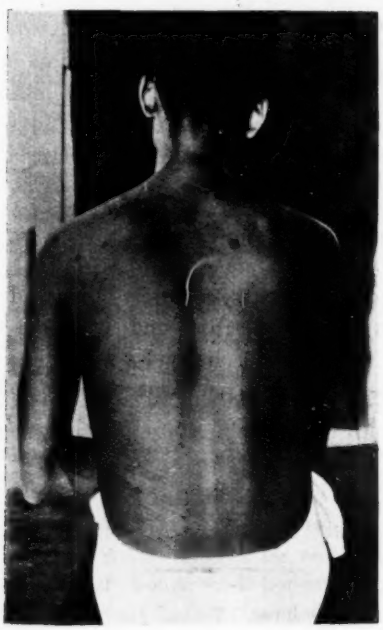
In the second case (S.N.G.) pin-point papular eruptions appeared all over the body two days after a total quantity of 2·5 grms. The eruptions were at first discrete but subsequently became confluent and was associated with intense itching and hyperaemia of the surrounding skin. In five days the patches began to turn black and in three weeks most of them faded away. 14 months after, when the patient sought re-admission only a few brownish patches were left on the face, abdomen and back. Strangely enough, with the appearance of dermatitis the patient who was running a temperature of 100°F., became afebrile and remained so till discharge. In the third case (P.G.B.) papular eruptions appeared 3 weeks after 3·5 grms. The patient had albuminuria immediately preceding as has already been referred to. The papules gradually became flat and blackish, but unlike the preceding cases des-

quamation occurred in about a week leaving very little trace behind.

The fourth case (K.N.B.) is rather interesting. The patient had 14 injections amounting to 7·8 grms. and was discharged with his disease arrested. Throughout the course of treatment he had no trouble excepting signs of immediate reaction. 9 months after he had left the hospital, he developed black spots and sought our advice. His history was that these appeared as red eruptions with some amount of itching and



turned black in 2 to 5 days. We have now an opportunity of observing this patient, as he has been readmitted for a slight recrudescence following an attack of malaria. The spots have not undergone any appreciable change. The condition semewhat resembles what has been referred to as "chrysiasis" by CHRISTENSEN. It is said to be due to the action of sunlight precipitating gold in the skin and thus causing a permanent discoloration—a condition closely resembling argyria. In our case these patches are distributed all over the body specially back and face, but this may be explained by the fact that people in this part of the country are in the habit of exposing most part of the body to light



at least during some part of the day. As to how far we are right in our assumption, time alone can show.

Jaundice. Occurred only in one case after 1·8 grms. It passed off in 3 to 4 days' time. The next injection in the same patient caused skin rashes (*vide* case 1).

Focal Reactions. These mostly occurred in very advanced cases and even with such minute doses as 0·01 grm. It was only in two cases that an overdose produced activation of the quiescent foci, in one after 3·6 grms. and in the other after 3·5 grms.

CUMULATIVE ACTION.

It is difficult, from the number of cases and limited period of stay of our patients, to come to a conclusion as to how long gold is retained in the system. But as skin rashes developed even after 9 months (*vide* case No. 4 under Skin Eruptions), the possibility of

accumulation and consequent toxic effects cannot be overlooked.

Results of Treatment.

It is very difficult to estimate the results of Sanocrysin treatment when the majority of cases in our series were treated with A. P. in addition. Our classification of cases in the accompanying table was based on the type of pulmonary lesion and the line of treatment adopted somewhat resembling the plan of grouping adopted by Burrel. This classification is preferred to Turban Gerhardts', because in judging the results of treatment, type of the disease and the course taken by it are, in our opinion, far more important than mere anatomical extent.

From a study of the table on page 306 it will be seen that the number of exudative cases of very recent origin was 1 or 3·1 per cent. of our cases. The results for group 2 and 3 in which Sanocrysin was combined with A. P. and which consisted of a number of late exudative cases are on the whole satisfactory. These two groups together with 2 cases of group 4 in which A. P. was successful consists of 18 cases (or 56·2 per cent) of the total number. Out of them 12 (or 66 per cent.) were discharged with negative sputum and in another 5 (or 27·7 per cent.) the number of bacilli were considerably reduced. All the six cases in our series in which arrest of physical signs was brought about belong to these groups. 3 cases of these two groups had laryngitis. In 2 the voice improved and in none of them had Sanocrysin any deleterious effect. Laryngitis is, therefore, not a contra-indication for Sanocrysin treatment.

Chronic fibrocaseous cases (group 4) excluding the two cases in which A. P. was combined with Sanocrysin constituted 5 (or 15·6 per cent. of the total number). Only one of them, or 20 per cent., was discharged with negative sputum and in none of them was the arrest of disease possible.

The 5th group of advanced bilateral cases with profound systemic disturbance, consisted of 7 cases, or 21·8 per cent. None of them showed any improvement whatsoever ; on the contrary in as many as 6, or 85. 7 per cent. even injections of small doses (0·01 grm. to 0·05 grm.) caused an exacerbation of the disease and rise of temperature which in most cases could not be controlled. In one case belonging to this group, two injections of 0·05 and 0·1 grm. were followed by such acute spread of disease that the patient steadily sank and died in about 6 weeks.

Sanocrysin was given in only one case of true fibroid phthisis. Quantity of expectoration and number of bacilli were reduced and the patient gained in weight but there was not the slightest improvement in physical signs.

Let us now consider the effect of Sanocrysin as a whole on different signs and symptoms. The results are shown in a tabular form.

(I) *Effect on physical signs.*

Total No. of cases.	Physical signs totally arrested.	Considerably improved	No improvement.
32	6 or 18·7 per cent.	9 or 28·1 per cent.	17 or 53·2 per cent.

(II) *Effect on Sputum.*

Total No. of cases.	Cough & sputum completely checked.	Frequency & amount markedly reduced.	No Improvement.
32	8 or 25%	14 or 43·8%	10 or 31·2%

(III) *Effect on Tubercle Bacilli in Sputum.*

Total No.. of cases.	Negative.	Number markedly reduced.	No Improvement.
32 All positive before treatment.	13 or 40·6%	12 or 37·5%	7 ar 21·9%

In 3 cases the sputum after remaining negative from 9 to 12 months again became positive.

No.	GROUPS.	No. of cases.	Effect on physical signs.			Sputum			T. B. (All positive on admission.)			Tempereture.					Weight.				REMARKS.
			Arrested.	Considerably improved.	No improvement.	Cough and Sputum entirely checked.	Frequency of Cough and quantity of Sputum reduced.	No Improvement.	Negative.	Number reduced.	No Improvement.	No fever when injection started.	Rendered afebrile.	Markedly diminished.	Not affected.	Worse.	Gained.	Lost during first few injections & then gained.	Lost.	Stationary.	
I.	Exudative cases of very recent origin ...	1	...	1	...	...	1	...	...	1	...	...	1	1	...	...	1	...	...	...	
II.	Apparently unilateral cases where A. P. was first induced in one lung and Sanocrysin was added as an adjunct at a later stage to prevent or check spread of disease in healthier lung ...	5	1	2	2	1	4	...	4	1	...	2	1	1	1	...	3	1	...	1	
III.	Active tuberculosis of both lungs more in one than in the other where Sanocrysin was combined with A. P. from the very beginning ...	11	4	4	3	5	5	1	6	4	1	1	5	4	...	1	7	1	2	1	
IV.	Chronic fibrocaseous cases with or without cavity and with only moderate systemic disturbance. (A. P. was attempted in 5 cases of this Group; in 3 it proved unsuccessful and in 2 successful) ...	7	1	3	4	2	3	2	3	3	1	...	2	2	2	1	4	1	1	1	The arrest of physical signs in the only case of this group and 2 out of 3 of negative sputum occured in 2 cases where A. P. was successful.
V.	Advanced cases with profound systemic disturbance and destructive lesions in both lungs ...	7	...	...	7	...	...	7	...	2	5	...	...	...	1	6	1	...	6	...	
VI.	Fibroid phthisis without any evidence of destructive changes ...	1	...	...	1	...	1	...	...	1	...	1	...	...	...	...	1	...	...	...	
	TOTAL ...	32	6	9	17	8	14	10	13	12	7	4	9	7	4	8	17	3	9	3	

(IV) *Effect on Temperature.*

Total No. of cases.	No fever before treatment.	Rendered afebrile.	Temperature markedly diminished.	No Change.	Worse.
32	4 (12·5%)	0 (28·1%)	7 (21·9%)	4 (12·5%)	8 (25%)

(V) *Effect on Weight.*

Total No. of cases.	Gained.	Lost during first few injections and then gained.	Lost.	No Change.
32	17 (53·2%)	3 (9·35%)	9 (28·1%)	9 (9·35%)

(VI) *Effect on Skiagram and Sedimentation Velocity of R. B. C.*

It is not possible to compare the skiagram of Sanocrysin patients before and after treatment, as the number of skiagrams of such cases was not great. In one patient, in whom such comparison was possible, the more diseased lung had been collapsed by A. P. and some amount of fibrosis appeared to have taken place in the opposite lung.

In 3 cases only the Sedimentation Velocity of R. B. C. before and after treatment was compared. The two-hourly rate in the first case came down from 62 to 48; in the second from 73 to 60; and in the third from 77 to 35. All these patients were treated with A. P. in addition and no definite conclusions can be drawn.

CONCLUSIONS.

Two things must be borne in mind in forming our conclusions. In the first place the amount of clinical materials is not sufficiently, large to arrive at any definite conclusion; secondly, early exudative cases, which are regarded as best suitable for Sanocrysin treatment, were few in our series. However, the analysis of the cases described points to the following conclusions:

(1) That it is a valuable adjunct to Pneumothorax treatment. In most cases of our series, induction of A. P. would not have been possible if Sanocrysin did not help to clear up the less affected lung. Even in cases apparently suitable for A. P. treatment, such treatment could not have been continued if Sanocrysin did not help to prevent or check fresh spread of disease in the healthier lung.

(2) That it is worth a trial in chronic fibrocaseous cases where A. P. frequently fails on account of pleural adhesions.

(3) That it is positively harmful in advanced bilateral cases with profound systemic disturbance and great caution and judgment should be used in giving Sanocrysin in these cases even for the sake of a trial. *

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(3) BURREL, L. T. S., Recent Advances in Pulmonary Tuberculosis—Churchill, 2nd edn.

(4) STUB-CHRISTENSEN, Sanocrysin Treatment, Tubercle XIII, 49.

* Paper read at the Scientific Section of the VIII All-India Medical Conference held in Calcutta, March, 1932.

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Editorial Comments

The name of ROBERT KOCH marks an epoch in medical research. Shy, silent and sensitive, extreme in his likes and dislikes, he stands out as a towering personality, whose name is held in reverence by the world to-day as a great benefactor of humanity. ROBERT HEINRICH HERMANN KOCH was born of a middle class family on the 11th December, 1843 in Clausthal, Hannover in Germany. He was the third of the thirteen children of his parents and inherited love of nature and desire for wandering from his father, diligence and amiability of character from his mother. His early years were spent in the village school and at the leisure moments he would go collecting insects and stones. He entered the University of Gœttingen in 1862, and took up natural sciences and medicine for his studies. On the 13th January, 1866 he passed his *tentamen rigorosum* and three days later doctorate was conferred on him. On the 16th March, 1866 he passed his State Examination in "Anatomy" from Lavestrasse in Hannover and thus qualified to practise medicine. Prominent amongst his teachers were HENLE, HASSE and MEISSNER, who aroused in him the keen sense for scientific investigation His first original research was done under the direction of HENLE and KRAUSE in 1865 for which he was awarded the first prize of 80 thaler. This was the end of his somewhat smooth course of university studies but the beginning of his hard yet fascinating and remarkable career.

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KOCH, who was regarded as an epoch maker in his later years, found himself lost in his early days. He was not inclined to jump into the uncertainty of practice and sought in vain a position in the military medical service. Goaded by hunger and prompted by a desire "to see something of the world and gather some experience" he went to Hamburg to apply for the post of a ship's surgeon. His bride EMMY ADOLFINE JOSEFINE, whom he married on the 16th July, 1867, was opposed to the idea and he came back from Hamburg after a few months' fruitless search for employment. After all, however, he obtained a post in the asylum for idiots in Langenhagen near Hannover. He was happy and comfortable but as fate would have it there was retrenchment in service and he had to give up his job and start practice in Niemegk. He was such a failure that he seriously thought of migrating to the U. S. A. where his other brothers had settled. He decided to take, however, another chance in the little village of Rakowitz, only to be interrupted by the Franco-German War. He was for sometime in the active military medical service. After his return he set up private practice again in Rakowitz. In the winter of 1871-72 with an eye to entering state service he passed an examination and through the kind recommendation of FREIHERR VON UNRUHE in Bomst got a post as medical officer in the village Wollstein of only 4000 inhabitants. While practising in this village, he could just afford to equip "a small laboratory and even maintain experimental animals" in his consultation room, which he divided into two parts by a curtain. His equipment consisted of an improvised microcamera and a Hartknack's microscope—a present from his wife.

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Working in this laboratary KOCH obtained a pure culture of anthrax bacilli. On the 30th April, 1876, he surprised such eminent scientists as COHN and CONHEIM by demonstration of this culture and also "spore form" of Bacillus anthrax in the Plant Physiology Institute of Breslau but was coldly received by VIRCHOW in Berlin. In 1878 he postulated his now famous laws of bacteriology. In 1879 he went to Breslau on the invitation of COHN to accept a post in the university but resigned on the ground of insufficient salary and came back to his little village Wollstein.

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About this time he was called to take up the newly created post of the Director of Vaccinations in the Imperial Department of Health in Berlin, which he accepted. Although his income would be less in Berlin than at Wollstein, he decided to go in the hope that he would be free to study, with able collaborators, pestilence and disease. Amongst his collaborators could be found the names of many eminent physicians—GAFFKY, LŒFFLER, GARTNER, FISCHER, PROSKAUER, WOLFFHUEGEL and HUEPPE. His first work from this institute was on "Examination of pathogenic micro-organisms." During the course of this study—the study of cholera, plague and other acute epidemic diseases—the problem of tuberculosis appeared to him more and more important.

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Following the clue given by VILLEMIN, CONHEIM and SALOMONSEN about the mode of transmission of "Iris tuberculosis" in experimental animals KOCH worked hard for six months in the winter of 1881-82, and succeeded in making one of the greatest discoveries of the century. On the 24th March, 1882, under the chairmanship of EMIL DU BOIS-REYMOND, KOCH delivered a lecture on the "Etiology of Tuberculosis" in the Berlin Medical Society and demonstrated the bacillus of tuberculosis. This lecture by its clearness of setting, thoroughness of study, modesty of description and caution in drawing conclusions made a most lasting impression. His name went round the world.

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Soon after this his eminent colleagues LŒFFLER and GAFFKY settled the etiology of diphtheria and typhoid fever. KOCH with GAFFKY, FISCHER and TRESKOW went on an official commission to Egypt and came to our own city of Calcutta to study the problem of cholera. Working in the Medical College Hospital in Calcutta, KOCH examined 16 cholera patients and 32 dead bodies and made another epoch-making discovery—he identified the comma bacillus as the specific organism of this malady. After a flying visit to Darjeeling the commission returned to Berlin on the 4th May, 1884 and was received with great respect and enthusiasm in their fatherland. In the following years KOCH took part in several cholera conferences, notably in the International Cholera Conference in Rome and in 1885 he was appointed to a chair in the Berlin University and Director of the Institute of Hygiene.

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As Professor of Hygiene he created another great sensation by an announcement in the 10th International Medical Congress in 1890 that he had "prepared an agent, which inhibits the growth of tubercle bacillus not ony *in vitro* but also in animal bodies." From experience he would "take it that early phthisis can be cured with certainty by means of this agent". In the following year he gave out that "this substance is a glycerine extract of pure culture of tubercle bacillus", which he named "Tuberculin." Six years later he modified its method preparation and described T. A., T. O., and T. R., still in vogue. Although the expectations then aroused of a cure were not fulfilled, and the enthusiasm with which this announcement was received dwindled down, its significance as a diagnostic means in tuberculosis still holds good. At the Congress on Tuberculosis, held in London in 1901, KOCH maintained that tuberculosis in men and cattle is not the same disease—a question which is still baffling the scientists. In 1893 KOCH resigned the professorship of hygiene and became Emeritus Professor in the University, and Director of the newly established Institute of Infectious Diseases in Berlin, which after his death was named Robert Koch Institute.

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In 1896, KOCH investigated the nature of rinderpest in South Africa and found means to combat it and in 1897 undertook another journey to India, particularly Bombay and Madras, to study the problem of plague and confirmed the etiological significance of bacillus pestis, discovered by KITASATO and YERSIN, and emphasised for the first time the roll of rats in the transmission of this disease. Subsequently, he travelled extensively in pursuit of study, and was summoned in 1903

again to South Africa to advise on cattle diseases. On his return to Berlin, he retired from the position of Director of the Institute of Hygiene and was elected a member of the Berlin Academy of Sciences.

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In his retirement he never changed his daily routine. He attended every morning the Institute of Infectious Diseases and avoided any interference with the administrative side, now directed by his former colleague GAFFKY. During the six years he lived after retirement, he spent some months in East Africa and elsewhere investigating sleeping sickness and other diseases. Honours were showered upon him and after a lecture on the 10th December 1905, in Stockholm, he was awarded the Nobel prize for medicine.

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On the 27th May, 1910 KOCH died of heart failure in Baden-Baden. This day six years later a marble statue of the great savant was unveiled in Luisenplatz in Berlin, overlooking the old Imperial Department of Health—scene of his labours 30 years ago, from where he revealed the marvels and wonders of modern bacteriology.

KOCH was undoubtedly one of the greatest bacteriologists ever known.

Medical News and Notes

[Items of news and notes of general interest to the profession for incorporation in this section from the members of the profession will be greatly appreciated—EDITOR]

Burnley's War on Tuberculosis. In his report on the institutional treatment of tuberculous persons and the after results of such treatment during the period from 1st January, 1927 to 1st December, 1931, The Medical Officer of Health has presented to the Public Health and Maternity Sub-Committee of the Public Assistance Committee of the Burnley Town Council the following :

"I have reviewed the extent of treatment provided during the 5 years 1927-31, and prepared a statistical report. During this time 489 cases of pulmonary tuberculosis and 45 cases of non-pulmonary tuberculosis were sent to sanatoria. Of the pulmonary cases 217 were early cases, the remainder being in an intermediate or advanced stage of the disease. More than half the cases of pulmonary tuberculosis went to Meathrop Sanatorium. The pulmonary cases were on an average 148 days under treatment in sanatoria. Those suffering from the disease in its early stages had a longer period of in-patient treatment than the more advanced cases. The patients suffering from surgical tuberculosis, as is to be expected, were under treatment in institutions for a longer period than those suffering from tuberculosis of the lungs.

"On discharge from sanatoria the disease was quiescent or arrested in 110 cases of lung tuberculosis, and 200 persons were definitely improved. Out of the 498 cases of tuberculosis of the lung only 44 died in institutions while undergoing treatment. Of 45 cases of surgical tuberculosis 33 were improved or the disease had become quiescent, and only two died while undergoing treatment. Of those who had sanatorium treatment during the last 5 years, about one-third are now working or attending school or fit for work or school. One hundred and five, although not fit for work, are able to get about, and only 7 are at present wholly confined to bed, and less than a third of the patients are now dead.

"The average cost per case of sanatorium treatment of pulmonary tuberculosis is £ 50 per patient, and for non-pulmonary tuberculosis £ 53 per patient. This cost cannot be considered excessive when it is understood that the average duration of stay of pulmonary and non-pulmonary cases is over 21 weeks and 23 weeks respectively.

"One of the advantages in sending tuberculous persons to sanatoria for lengthy periods is the segregation of the patient from other members of the household, particularly children, and so diminishing the risk of other persons in the household developing tuberculosis."

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The Waning of Tuberculosis. What is the explanation of the decline of tuberculosis ? No need to question the fact when there are the Registrar General's figures for three-quarters of a century to corrobarate it. Certainly no more intriguing topic could be raised and the Society of Medical Officers of Health have debated it with gusto. This was partly due to the existence (but by no means the hostility) of a school who fear most the organism itself and of another who put their

faith in preparing an unsuitable soil for its growth. But to which of them do we owe the present position? The abolition of many a slum, the perfection of modern sanitation, the rise of industrial hygiene, and above all, the gospel of personal cleanliness including the revolt from the use of foul milk all have had their influence on a once ubiquitous foe lurking in darkness and dirt. But after giving every credit to the powerful onslaught of these factors, the debate made it clearer than ever that none of them have been so potent in effecting the revolution in the incidence of tuberculosis as are the developing and tending of the natural resistance. A vivid illustration of this was given from the remarkable frequency of tuberculosis among the youths of a training stable, obviously due to their meagre dietary and persistent weight reduction. One speaker proclaimed our special debt to the plumber, who despite some vistiges of ingrained villainy, is incapable of reproducing the atrocities of nineteenth century sanitation. And second only to this paragon he ranked the statesman who repealed the soap-duty All honour to them both.

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The effect of Tuberculosis on Diabetes. E. LUNDBERG confirms from his own experience, the opinions of other observers that in cases of tuberculosis in diabetics the tendency is for the glycosuria to improve *pari passu* with the advance of the tuberculosis. To this extent the action of the tubercular process is beneficient, since the acetonuria disappears, the carbohydrate tolerance approaches normal, and acidosis is either absent or relieved, as is also the case with furunculosis and other skin affections. The final proof is afforded by the bad influence of insulin, which if persisted in, gives rise to sudden and serious attacks of hypoglycaemia. In all LUNDBERG's patients the deaths were due to the tuberculosis. (Stockholm: Acta Medica Scandinavica).

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Slimming Danger. A warning against the dangerous effects of "Slimming" is uttered in the report on tuberculosis presented by the Medical Officer of the Paris Municipal Council. The report reveals an alarming number of cases of women who made themselves ill and developed tuberculosis through dieting.

Apart from the increase in the illness through this cause, the report is a remarkable testimony to the efforts made by the public health service in their fight against tuberculosis. In the last fifteen years the number of persons in every 10,000 who died from this disease in Paris has been reduced from 28 to 20.

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Shropshires's Fight Against Tuberculosis. According to the report for 1930 of the County Medical Officer of Health for Shropshire, there were 4,095 births in the County during 1930, or 23 less than the previous year. The County's birth rate was 16·79 and that for England and Wales 16·3. The death rate was 12·12 for the County, and the figure for England and Wales was 11·4. The number of deaths was 2,949 or 405 less than in the previous year.

Comparing the figures for 1930 with those of previous year, the number of deaths from pulmonary tuberculosis decreased by 41, while the number of notifications increased by 10. The deaths from non-pulmonary tuberculosis on the other hand increased by one, while the notifications decreased by 19.

The greatest death rate from pulmonary tuberculosis, it is pointed out, is between the ages of 15 and 45. The high death rate in the young adults is one of the most baffling facts in the tuberculosis problem of to-day, and in an answer to question, why does the young adult succumb to tuberculosis lies the solution of one of the most difficult problems of anti-tuberculosis work. A higher incidence of non-pulmonary tuberculosis would consequently be expected in the earlier years of life when opportunities for infection were greater owing to that being the great milk-drinking age. There was a high morbidity in the cattle type of infection, as there were 70 cases of non-pulmonary notified, as opposed to 8 cases of the pulmonary type. It would be seen that there was still a great danger from infection by milk. The ideal was, of course, a tubercle-free milk for children, but as that was neither practicable or possible at present it would appear that the only method of dealing with that type of infection was to insist on all milk given to children being boiled.

Annual Reports

Mary Wilson Sanatorium.

26TH ANNUAL REPORT 1931.

The junior staff this year has consisted of two teachers, two staff nurses, one Baby Fold attendant, matron, three student nurses, and the nurses who come from Bareilly for affiliation. We have also had several patients who did part time work in the school, dispensary and wards and whose work helped us a great deal.

Baby Fold. We have had six to eight children in the baby fold most of the year. These children come when their mothers come as patients. They are usually sent to us as "healthy" children but we find on examination that all of them show signs of having been infected. So they receive regular preventorium treatment, sunbaths, rest, special food, and medication. Most of these children attend the Kindergarten class in school.

School and Sunday School. Since the opening of school in July there has been about twenty five children in school. The classes are irregular as both pupils and teachers are only allowed to go to school when the doctor gives permission. There is also language difficulties. We have three class A : Hindi, Urdu and Gujrati. A school garden this year has given the children much pleasure and healthful exercise. Our two teachers have had much valuable help from several of the patients in the school work this year.

Sunday School and Church are held regularly in our church. There are also classes conducted in two of the big wards where the patients are not able to walk to the church. The Kindergarten class is one of the largest and most interesting class.

The Sewing and Gardening class for the older patients as well as the children has done very good work this year. We find as in all Sanatoria that cures come faster and the patients live a happier life when suitable tasks are provided for all. In this respect we are badly in need of trained helpers to work with our patients. In addition to her school work and with the help of a very efficient little cripple patient, one of our teachers looks after some of this work as best she can, not having had training for such work.

Nurses' Training. In October four nurses took their first year nurses' examination under the N. I. Examination Board. They were given their training and instruction through the year by the Superintendent and the Asst. Medical Director. These girls will go elsewhere for further training, as we give only one year of training, including lectures on Tuberculosis and School Nursing. A three months course on the last named subject is given to the students of the Bareilly Hospital. We have had 21 nurses take this course.

Patients. During the year there was a total of 147 patients treated in the sanatorium.

Total No.	Patient days	24,813
" "	Admissions	53
" "	Dismissals	68
" "	Deaths	8
Average length of stay		5 1/3 months.
Daily Average		68 patients.

Of the 68 dismissed the results were as follows :

Unimproved.	1
Transferred as Non-Tb.	7
Improved.	16
Apparently arrested.	44

of those dismissed 5 were of other missions, 3 were Hindus, and 1 Mohammadon.

Laboratory examinations numbered 360.

We had a slightly smaller number of patients this year but a larger number of dismissals. We have fewer third stage cases this year. The majority of our cases are first stage and preventorium children. Most of the patients made good gains throughout the year. We had a slight epidemic of influenza in August and quite a number of cases of malaria and one of dengue.

Dispensary. In our outdoor dispensary we aim to treat only those people who can not go elsewhere for treatment, such as our own servants and the nearby villagers. Sometimes we have difficulties persuading those who need hospital care to Ajmere or Jaipur but we do so whenever possible, as we need to concentrate our efforts on our tuberculosis work.

The dispensary report for the year is as follows :

Maternity cases.	4
Major operations.	3
Minor operations.	111
In-patients.	17
Total No. Treatments.	5,755
Total No. patients.	1,091

During the year we were the happy recepient of a gift of Rs. 1800 from the "Lady Irwin Fund" administered by the A. G. G. at Ajmere. The fund was created by the Maharajah of Jaipur at the occasion of his ascending the throne last March.

We have much to be grateful this year. In spite of difficulties and disappointments we have had a year full of blessings and triumphs. The most encouraging result of our year's work has been the sending of so many women and girls back to their homes and schools again well and happy. We dismissed 45 apparently arrested cases. We know that many of these have been restored to useful happy lives of service for the Master. This is the special reward which doctors and nurses enjoy and which is ample remuneration for our labours. May God continue to bless our efforts as he has this year.

Health Department. This year the report of the Health Department covers only 11 months. 15 schools have been visited and 1211 children were examined. The boys, who are in our girls schools, are included in this number.

In Pauri the teeth of all those in the Boys' school were examined to see if they would be justified in having the Oral Hygienist.

For the past year Miss Dunn has been Secretary of the Health Visitors' League in connection with the Trained Nurses Association of India. It means a bit more work, but we have had quite a good many letters of inquiry regarding the Crusade and the health work in our schools, besides requests for literature from our Health Department from Burma, India, Sind and Kashmir.

We feel that health teaching and annual health examination with corrective work are worthwhile in our schools, and are glad to share with this large family outside our own mission.

We tried to make the Hindustani menu correspond as nearly as we could with the "Ideal Diet" for milk, vegetables and fruits besides the ordinary dal, bhat, curry, chappati and kichri.

Last November four talks were given to a group of Bengalee mothers in Sangrampur, Bihar. These women are the mothers of three-fourths of the girls in our Pakur school. We went to them in their village, lived in tents on the church compound, visited in the homes mornings, and had the meetings in the little mud church afternoons.

There is increased interest in health work and more follow-up work is being done each year.

This year we have the help of an oral Hygienist and our schools are taking advantage of the opportunity thus afforded. *(Extracts from the Superintendent's Report).*

Jadabpur Tuberculosis Hospital.

REPORT FOR 1931.

History : The high incidence of tuberculosis in Bengal called urgently for the erection of a sanatorium for the treatment of tuberculour patients. The absence of any such institution was a serious defect in the province and it was not until the year 1918 that the first step was taken to remedy this. It was left to the generosity of a private gentleman, himself a victim to this fell disease, to give a lead in this direction. SJ. PROVASH CHANDRA GHOSH, son of the late DR. CHUNDER MOHAN GHOSH, left by will the whole of his property to a Board of Trustees for the purpose of the "establishment of a Tuberculosis Ward in some hospital, or for the founding of a Hospital or Sanatorium or Nursing Home for the treatment of consumptives." Out of the assets of this estate the Trustees purchased a small area of land at Jadabpur and erected a small cottage hospital, which, in the year 1923, accommodated only four patients. The entire management of the institution was vested in the Calcutta Medical Aid and Research Society, registered under the Charitable Societies' Act. In course of time additional plots of land have been acquired and a double-storeyed building erected from funds collected from both private and public agencies. The hospital now consists of a well-equipped block for patients, nurses' and menials' quarters and outhouses, standing on extensive grounds, with its own electrical plant, water supply and sanitary arrangements.

Situation : The Sanatorium is situated at Jadabpur about six miles south of Calcutta, easily accessible from Calcutta both by road and rail. The Eastern Bengal Railway station, Jadabpur, is only a few hundred yards distant from the premises. In the selection of this site, the Society was guided by many considerations. Their first consideration was how best to serve the interests of the large and poorer sections of the population of the city, where the incidence of tuberculosis is highest. Their next aim was to work at as low a cost as possible by enlisting as far as possible the honorary services of the best medical workers in the city. It was felt that these objects would be achieved by selecting a site, which, while away from the congestion of the city, would be easily accesible to patients, doctors, and also to the relations and friends of patients. Not only would patients be saved the expenses and inconvenience, thereby, of travelling to distant sanatoria; but this proximity to relations and friends would, apart from the good reaction on the patients themselves, provide an opportunity of spreading knowledge in methods of prevention from infection and general rules for the treatment of tuberculosis. Proximity to the city has another advantage in that it allows workers in the city in the initial stages of the disease to undergo treatment, while increasing the value of the institution as a centre of propaganda and research work.

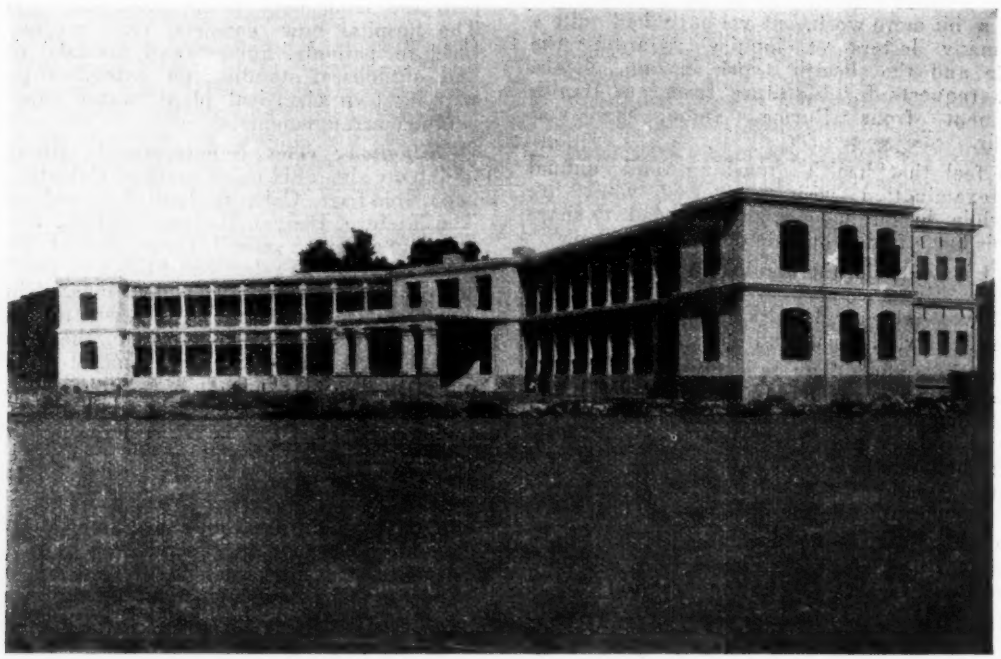
Climate : The necessity for certain types o climate in the treatment of tuberculosis is often exaggerated or mistaken. Apart from the fact that most people find it impossible to proceed to health resorts, the value of treatment in a "home" climate is now well recognised and climate at Jadabpur has not been detrimental to the treatment of tuberculosis. The temperature at Jadabpur is 70° F. in summer and is 100° F. in winter. The former is considerably alleviated by a refreshing south wind from the Bay of Bengal and the latter by the monsoon during the hot weather. Unlike some sanatoria, which have to

be closed periodically, the Jadabpur Hospital remains open throughout the year.

Accommodation : The number of beds available is fifty. Each patient has a cabin to himself so designed that sufficient fresh air and sunlight is available. There are four special cabins. Each cabin is provided with a bedstead, mattress, chair, hatrack and a side-table. At present one wing of the building is set apart to accommodate 12 female patients.

accommodate 114 patients, 109 being new admissions during the year. The statistics show that about 55 per cent of admissions were discharged improved inspite of the fact that the number of advanced cases was very large.

Developments : Quarters for menials have been erected at a cost of about Rs. 8,000 and the work of filling several low-lying marshy plots of land within the precincts of the hospital, which was



New Block, Jadabpur Tuberculosis Hospital.

Equipments : The hospital is provided with an well equipped Laboratory with modern arrangements for examination of all clinical materials and also with an X-Ray plant. There is also a fully equipped operation theatre and all surgical cases of tuberculosis are admitted.

Maintenance : The Sanatorium is maintained by grants from the Calcutta Corporation, fees realised from patients, rents from a portion of the estate left by Sj. Provash Chandra Ghosh and partly by private donations.

Admission and Treatment of Cases : During the year 1931 about 400 written applications for admission to the hospital were received from patients belonging not only to the different districts of Bengal but also from outside the province. Besides, numerous verbal enquiries were made in the Society. But the hospital with its utmost capacity could only

entrusted to contractors during the previous year has been completed.

A library for the patients has been started and the hospital is now in possession of about 200 volumes. Arrangements for light indoor games for the patients have also been made

Needs of the Institution : The Society, in view of the developments already carried out, is in debt to the extent of about Rs. 60,000. What is primarily needed now is a large area of land in addition to what has already been acquired. This is required for the open-air treatment and regulated exercises of patients which are so essential under the modern system of treatment of tuberculosis. The Society should also make every effort to provide ample means for the recreation of patients, It is estimated that about 100 bighas of land will ultimately be required for the completion of the

scheme the Society have in view. An area comprising more than 26 bighas being already in possession of the Society the remaining 74 bighas would cost a sum of about Rs. 2,60,000 for acquisition and another Rs. 50,000 for the development of the land. Construction for additional quarters for the staff would require Rs. 50,000. The installation of gas in the hospital is an immediate necessity to facilitate sterilization and laboratory works and this has been estimated at Rs. 6,000. A storage battery for the Electric Power House should also be purchased as early as possible to provide facilities for supply of electricity at any hour of the day or night and this would cost approximately Rs. 5,000. The total requirements of the Society are, therefore, Rs. 4,31,000.

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1,00,000 people die of Tuberculosis in Bengal every year One million of the population are infected. The incidence has risen 150 per cent. during the last eight years and is still rising.

What this means in human suffering, broken homes, woeful parents and distressful children, in economic waste and human want, can hardly be imagined.

The Jadabpur Hospital is doing its utmost to stay the progress of this terrible scourge, but it needs the help of all in this formidable task.

It is only with the good-will and co-operation of all that the Jadabpur Hospital can hope to cover its liabilities for the cost of construction and acquisition of land (Rs. 60,000) to build quarters for the staff (Rs. 50,000), to acquire land which is most essential to its purpose (Rs. 2,60,000) to develop the land (Rs. 50,000) to instal gas (Rs. 6000) and to buy a storage battery (Rs. 5000) in all Rs. 4,30,000. For the development and extension of its work in any measure adequate to the needs of Bengal, considerable funds are needed. No worthier object for the charitably minded could be found. If each gave something all would be found.

Current Medical Literature

Intra-muscular Calcium Therapy in Pulmonary Tuberculosis.

Münch. Med. Wschr. 78 p. 1741. 9th Oct. 1931.

UNDRITZ studied the effect of intra-muscular injections of calcium gluconate in sixty patients with tuberculosis. The injections are given every other day alternately in gluteal muscles. Intravenous injections of calcium gluconate are advisable in cases of haemorrhage and a prolonged intra-muscular injection may be followed by a series of intravenous injections. The author gives the report in sixty cases and a detailed one of three cases. He concludes that intra-muscular calcium therapy is advisable in all forms of pulmonary tuberculosis but in patients with high temperature and poor general condition the injection of calcium gluconate should be postponed until the active manifestations have somewhat subsided and the general condition has improved by camphor therapy. Patients with pleural exudation and patients with pneumothorax treatments are suitable for calcium therapy for in these cases the inhibiting action of calcium on exudation is of special value. He recommends prophylactic administration of calcium one or two weeks before pneumothorax is induced. He points out that calcium administration is not a casual therapy and that not all patients are benefited by it but he considers it a valuable adjuvant. According to him, the efficacy is not due to calcium deposit but in passing through the organism it displays pharmacodynamic actions *e.g.*, increase in phagocytosis, checking of inflammation and exudation. *J. N. Dutt.*

Leucocyte changes following injection of Sanocrysin in Pulmonary Tuberculosis and their significance.

HUGHES & SHRIVASTAVA

Ind. Jour. Med. Res. Vol. XIX
No. 2. Oct. 1931, p. 585.

The authors studied the blood changes following injections of Sanocrysin in 13 patients suffering from pulmonary tuberculosis and in 4 non-tuberculous subjects and report :

(1) When improvement in the symptoms and physical signs followed administration of the drug to tuberculous patients, there was a rise in the lymphocytes which usually began on the second day and continued for 4 to 7 days according to the dose administered. A similar change was seen in the non-tuberculous subjects.

(2) When there was no improvement and more especially when the effect was harmful the lymphocyte either fell or remained stationary.

(3) In all except a few instances a temporary rise in the monocyte occurred. The authors suggest that Sanocrysin stimulates the curative processes already going on in pulmonary tuberculosis. *J. N. Dutt.*

Treatment of Tuberculous Diabetic Patients.

KUTSCHERA & AICHBERGER.

Wien Klin Wschr. Sept. 25, '31 p. 1217.

The authors assuming that the low resistance of diabetic patients to tuberculous infections due to low sugar consumption of the tissues, attempted to increase the sugar consumption in three cases of diabetes with severe exudative tuberculosis. On administering large amounts of carbohydrate and corresponding amounts of insulin, the tuberculosis lost its former malignancy and took an unusually mild course. Besides the dietetic treatment, the collapse therapy should be instituted earlier because in these patients the tuberculosis is more progressive than in other persons. The authors point out that in diabetic patients the tuberculosis is almost symptomless in the beginning and causes no other clinical disturbance than a reduction of carbohydrate tolerance and when finally clinical symptoms such as fever become noticeable the tuberculous process has already reached an advanced stage. Besides the improvement in the tuberculous process the authors noted an increased sugar tolerance. In spite of greater carbohydrate intake the insulin requirements are now less than they were before.

J. N. Dutt.

Epicutaneous Tuberculin Reaction in Skin Tuberculosis.

NATHAN AND KALLOS.

Klin. Wschr. No. 52. Dec. 26. 1931 p. 2392.

The authors report that only cases of skin tuberculosis react to epicutaneous tuberculin application with an eczematous reaction, whereas all other tuberculous cases react negatively and react only to intracutaneous tuberculin application. The authors think that in cases of skin tuberculosis the skin is hypersensitive thereby giving the reaction whereas all other tuberculosis cases do not confer the hypersensitiveness to the skin necessary for the reaction.

J. N. Dutt.

Tuberculosis of the Jejunum.

WHITE & JANKELSON.

J. A. M. A. No. 1. Vol. 98.

Intestinal tuberculosis is a frequent complication of tuberculosis elsewhere, particularly of the lungs. At autopsy there are signs of tuberculosis of the bowels in approximiately 50 per cent. of those who die of pulmonary tuberculosis. Intestinal involvement may occur at any stage of the pulmonary infection, early or late whether active or apparently healed. Naturally it is more common in the advanced and active cases.

Multiple lesions are the rule. Any part of the bowel may be involved. The most common location is the lower ileum or ileocecal region. The jejunum is frequently involved in the terminal stage of an extensive tuberculosis of the bowels. It is rare, however, to find isolated tuberculosis of the jejunum without tuberculosis elsewhere in the bowel, as in the two cases, reported by the writers.

Symptoms of intestinal tuberculosis may be absent or very vague. Pulmonary tuberculosis causes many digestive symptoms even when the digestive tract is not directly involved. In focal lesions in the jejunum alone the diagnosis is often impossible except in cases in which stenosis or partial obstruction of the jejunum has occurred.

Stenosis is frequently the result of healing and fibrosis of tuberculous focus, is often partial or chronic and may be symptom free or cause mild vague symptoms, or more or less violent intermittent attacks of intestinal obstruction. Now the greatest difficulty is in finding out whether the stenosis is due to tuberculosis, cancer or adhesion. Rontgen examination is very important. Scout or plain films have been valuable in diagnosis. Repeated study of the small intestine pattern in the first six hours after a barium meal is necessary since evidence of partial obstruction is apt to be transitory.

Both the cases reported were secondary to pulmonary tuberculosis and are especially interesting because jejunum was the only demonstrable part of the bowel involved. In both cases a single stenosis was present while multiple stenoses are the rule in tuberculosis. Both were operated successfully.

In case No. 1 on operation a stricture 2½ feet below the duodeno-jejunal junction was found. Jejunum was tremendously dilated and thickened. There was a marked cicatrical narrowing of the jejunum to which another loop of small intestine was adherent. The peritoneum in this region was much thickened and very shaggy like that of an old healed tuberculosis. In case No. 2 there was a portion of jejunum 16 cm long with a constriction measuring 2·5 cm in circumference at the midpoint (the remainder of the bowel being 5 cm.) There was a rather ragged superficial ulceration at this point 3 cm in the greatest diameter. The ulceration was diagnosed to be tuberculous.

Case No. 1. has been living healthy for 5½ years after removal of the focus in the jejunum and the infection in the lung became arrested. Case no 2. died 3 months after operation at the age of 72 of pulmonary tuberculosis and myocardial weakness. So the treatment of tuberculous obstruction of jejunum is surgical by choice and medical by necessity.

S. Sarbadhikary.

Interlobular Collateral Respiration.

ALLEN & JUNG.

Jour. Thoracic Surgery Vol. 1 No. 1.

VAN ALLEN and LINDSKOG describe a newly recognised property of the lung. They showed that lobular divisions of the pulmonary air passages in dogs are connected collaterally rather than being independent as supposed. The interlobular septa are incomplete and the alveoli at the planes of fusion of the lobules communicate with each other by minute openings (probably the alveolar pores of KOHN). The communication comes spontaneously into use when the bronchi supplying one lobule or group of lobules become obstructed, for then the obstructed part breathes from the side through the adjacent free parts of the lobe. No such connection as this exists between the lobes. This function has been named collateral respiration.

Collateral respiration has the same significance in pulmonary function, as collateral circulation has in the function of vascular system. The bronchioles are fine and possess richly secreting surfaces and are obstructed to some degree with every attack of severe lower respiratory catarrh while the individual is conscious they are cleared up by vigorous coughing and breathing, but during sleep with shallow breathing and quietened cough, secretions accumulate, gravitate and fill up the slender ducts at the base of the lungs blocking the passage of air. After bronchial absorption has occurred, the imprisoned air undergoes absorption in an hour or so to such an extent that unless air has been constantly supplied by collateral respiration so little air is left in the occluded part that cough is ineffectual in expelling the obstruction. Therefore, were it not for the collateral respiration, the operation of the lungs in the presence of bronchitis would be inefficient.

They carried on a few interesting experiments in a series of dogs. Lobular bronchial obstruction was produced permanently by ligation of the main bronchus of the right lower lobe. Half of the series was treated further, some by introducing excessive amount of fluid into the unobstructed parts of the lobe, others by inoculating these bronchi with a chemical or bacterial irritant, and the rest by interfering with the movements of respiration in different ways. The remaining half of the series was used as controls, a few of which accidentally developed pneumonia and bronchitis and afforded the opportunity of witnessing the effects of spontaneously arising intrabronchial fluids and parenchymatous consolidation after lobular bronchial obstruction.

From the above experiments they found that collateral respiration was surprisingly efficient. Every small section of the lung lobe proved to be sufficient for aeration of the whole lobe. Collateral respiration may maintain the inflation of obstructed section of lung lobe when diaphragmatic function has been eliminated, and no other form of interference is added, also when large quantities of viscid coagulable fluid have been deposited in the bronchi of the rest of the lobe without other interference. In cases of introduction of a chemical or bacterial irritant into the bronchi of free lobules when the consolidation was complete or the lobules greatly inflamed the atelectasis of the ligated segment was complete otherwise the atelectasis being in proportion to the amount of consolidation of lobule or inflammation of interalveolar septa.

S. Sarbadhikary.

Tuberculosis Sanatoria in India

BEHAR & ORISSA

ITKI STATE SANATORIUM

OPENED in 1930.

The Sanatorium was established by the Government of Behar and Orissa for the treatment of phthisis patients in the early stage of the disease, on the same scientific lines as those which have proved successful in the western countries. It is situated on a beautiful elevated open place on the Ranchi plateau, about 2300 feet above sea level. It is 16 miles to the west of Ranchi town and within half a mile from the Itki Railway station, on the Purulia-Lohardag line. It covers over an extensive area of about 270 acres and enjoys a pure atmosphere free from dust and smoke.

ACCOMMODATION—The Sanatorium has accommodation for 50 patients namely 4 for Europeans or Indians living in European style : 14 Indian 'A' class and 32 for Indian 'B' class patients.

(1) EUROPEAN WARDS :—There are two separate blocks each containing accommodation for 2 patients. Each patient is provided with one room with spacious verandahs and with a bath room. There is a common dining room in each block. The rooms are all furnished. The charge is Rs. 100/- a month, payable in advance, which includes accommodation, treatment and diet. The patients of these wards may, with the Superintendent's permission, bring one servant each with them. The patients are supplied with linen and crockery.

(2) 'A' CLASS WARDS :—(*a*) 'A' class cottages consist of 4 separate blocks and each block contains 2 completely

private semi-detached quarters. Each quarter consists of 2 rooms with verandahs, a store room, kitchen and a private compound with bath room and privy. The rooms are furnished. The charge is Rs. 80/- a month, payable in advance, which includes accommodation, treatment and diet or Rs. 50/- without diet.

(*b*) OBSERVATION 'A' WARDS :—This block consists of 9 rooms and each patient is given 2 rooms, besides a kitchen with a store room attached. The charge is Rs. 70/- a month with diet or Rs. 40/- without diet.

(*c*) RECREATION WARDS contain 2 beds and their accommodation and charges are similar to the Observation Wards.

Milk will be supplied by the Sanatorium to all the 'A' class patients whether they take sanatorium diet or not.

(3) 'B' CLASS PATIENTS :—There are 2 large blocks, each containing accommodation for 16 patients. Each patient is supplied with bedding, as in the case of 'A' class patients. The charge is Rs. 35/8/- a month, payable in advance which includes accommodation, treatment and diet, or Rs. 18/8/- without diet, in which case a kitchen will be supplied.

Milk will, in either case, be supplied by the Sanatorium.

TREATMENT—Besides the routine sanatorium treatment consisting of rest and regulated exercise, plenty of fresh air and balanced diet, other special treatment carried out are—artificial pneumothorax, phrenic evulsion, ultra-violet light therapy, gold, vaccine and tuberculin therapy.

EQUIPMENTS—The Sanatorium has a well equipped laboratory and operation theatre and a most up-to-date X-ray plant. All the wards are supplied with electric lights and fans and sanitary bath rooms. Each ward is also supplied with pure tap water.

BENGAL

JADABPUR TUBERCULOSIS HOSPITAL AND SANATORIUM

(P. O. DHAKURIA, DIST. 24 PERGS.)

FOUNDED in 1923.

MAINTAINED by grants from Municipalities, District Boards, the Local Government, contributions from the benevolent public, and fees realised from patients.

LOCATION—The Hospital is situated six miles away from Calcutta and is accessible by a good road from the Jadabpur Railway Station on the E. B. Ry ; also by motor direct from Calcutta.

The area of the Sanatorium grounds is about 30 bighas, portions of which have been laid out as a vegetable garden.

EQUIPMENTS—The Sanatorium has its own X-ray apparatus, a Laboratory and a well equipped operation theatre. It has its own generating plant, arrangement for water supply and uptodate sanitary fittings.

ACCOMMODATION—There is accommodation for 50 patients, divided into general and special cabins. The fees are Rs. 2/- and Rs. 5/- per diem, respectively. A Block for advanced European patients is under construction.

Patients may be of any race or sex hailing from any part of India.

BOMBAY

TURNER SANATORIUM.

BHOIWADA, PAREL.

MANAGED by the Bombay Municipality.

ACCOMMODATION—32 patients ; 18 males and 14 females.

CHARGES—All patients are treated free of charge.

ADMISSION—Before admission, the patient is examined by the Medical Tuberculosis Officer to determine whether the case is suitable for admission or not.

TREATMENT consists in giving rest, fresh air and sunshine to the patients. There is provision for graduated exercise which is carried out under the personal supervision of the matron. Various injections are given, including gold ; Artificial Pneumothorax is performed in select cases.

DR. BAHADURJEE MEMORIAL SANATORIUM.

DEOLALI (CAMP.), BOMBAY.

ESTABLISHED in 1902.

MAINTAINED by the Parsi Community who meet the monthly expenses which come to about to Rs. 800/-

ACCOMMODATION—17 beds entirely reserved for poor Parsi patients.

CHARGES—Patients are treated free.

ATTENDANTS—The patients are attended to by relatives who are provided with a room that is entirely cut off from the patient.

CONVALESCENT HOME—The "B" Blocks have been kept apart for the convalescents who seek advantages of this climate after any other illness.

HINDU SANATORIUM.

KARLA, POONA.

FOUNDED in 1912 only for Hindu patients of both sexes. It generally remains open from the first week of October to the last week of June every year.

LOCATION—Nearest Ry. Stn. is Malavali, on G. I. P. Ry. line from Bombay to Poona. The distance of the Sanatorium is only 1¼ miles. Bullock cart or a *Doly* can be had by previous arrangement.

AREA is about 27 acres.

ALTITUDE—2025 ft. above sea level.

TEMPERATURE—Max. 105° ; Min. 45°.

RAINFALL—112 inches.

ACCOMMODATION AND CHARGES.—There are 40 beds. Patients are charged at Rs. 20/- p. m. as "Service Fee" for the use of a furnished cottage. He will have to make his own arrangements for food, clothing and medicines. Each paying patient shall have one cottage and shall not be allowed to have more than five and less than 2 attendants. Free Patients are not charged for lodging, medical treatment and attendance. One attendant is allowed to make arrangements for food etc. for which an allowance of Rs 10/- p. m. is given to them. "Paying" patients are charged for medicines etc. and the Medical Officer shall recieve Re. 1/- per injection, which fee is remitted in critical cases.

There is a Convalescent Home attached to the Sanatorium.

'BEL-AIR' SANATORIUM.

PANCHGANI.

FOUNDATION—A semi-charitable Institution, first established at Poona in 1912 and transferred to Panchgani in November 1914.

MAINTAINED partly from fees received from patients and partly from donations from the public.

LOCATION—Panchgani is 30 miles from Wathar and 63 miles from Poona, and there are regular motor services from both these stations. It is 4200 feet above sea level. The average annual rainfall is 45 to 55 inches. The Sanatorium

grounds cover 30 acres of land a gift of SIR DORAB J. TATA, KT.

ACCOMMODATION—The Sanatorium has separate accommodation for male and female patients. Some separate rooms are also available on special terms. The buildings are lighted with electricity and have extensive gardens. There is a Recreation Hall, a Club and a Library attached to the Sanatorium.

TREATMENT consists of rest, graduated exercises, Helio-Therapy, Ultra-Violet Rays, Vaccine and Tuberculin injections, Pneumothorax and all open-air methods. X Ray and high frequency installations have also been put up.

CHARGES—The ordinary monthly charges for a patient are Rs. 150 in the general ward, and Rs. 200 or upward for special accommodation; these include food, attendance, nursing, medical treatment and ordinary medicines. Pneumothorax treatment and Insulin treatment for Diabetes as well as Sanocrysin injections and other special medicines or injections will be charged at their cost. A nominal fee is payable every month by each patient to meet the X-Ray and Laboratory work. Patients who need special attention must bring their own servants who will be housed and fed at Rs. 20 per month.

GUEST HOUSE—Accommodation with board in the Sanatorium is available for relatives and friends of patients at Rs. 4 per day.

APPLICATIONS FOR ADMISSION should be made to the Superintendent of the Sanatorium, with the necessary Medical Certificate from the family physician, and his reply should be awaited before patients leave for Panchgani.

N. B.—Patients should bring with them sufficient bedding, blankets, and other warm clothing which are considered essential as well as a few utensils, a clinical thermometer, a set of knife, fork and spoon, a teaspoon, a washing basin and an aluminium jug.

Patients having any trouble in regard to their teeth, should have it attended previous to their arrival.

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MADRAS.

AROGYAVARAM OR THE UNION MISSION TURBERCULOSIS SANATORIUM.

MADANAPALLE.

ESTABLISHED by the united efforts of several Missionary Societies working in South India on July 19, 1915.

ALTITUDE—about 2500 ft above sea level. RAINFALL—about 28 inches. TEMPERATURE—Cold Season: bet. 70° and 80°F. Hot Season—bet. 95° and 102°F.

LOCATION—The Sanatorium covers about 100 acres with its more than 90 buildings and spacious compounds and gardens. The distance from Madanapalle Road station on M. & S. M. Railway is 4 miles by an excellent road.

MAINTAINED by the annual contributions of the co-operating Missions. It receives an annual grant from the Government of Madras. Also dependent on the income from paying patients and on private donations.

ADMISSION—There is no restriction to admission whatsoever. Unlike all other sanatoria in India, Arogyavaram openly admits patients in advanced stages of the disease.

ACCOMMODATION—The number of beds available in the Sanatorium is 197. There are 8 general wards, with a total of 116 beds. Six wards contain 18 beds each, four of these wards forming a unit for men and two, a unit for women. To each of these units is attached a smaller ward with four beds, intended for Anglo-Indian men and women respectively. The special wards contain one or two beds each; in the latter case the ward is divided by a partition. Patients in Special Wards are provided with a kitchen and supply their own food and cook. Each patient should be accompanied by one attendant in addition to cook.

RECREATION—Lantern lectures, musical evenings, small dramatic performances by members of the staff etc. are organised. Sports are also held on different occasions

CHARGES—Payment in the General Wards is Rs. 18/- per mensem. Free Beds—Indigent patients are admitted free of all costs on a certificate from a gazetted Government Official or from the representatives of the Missions on the Governing Body of the Sanatorium. Patients are charged Rs. 50/- to Rs. 150/- per mensem in the Special Wards according to the accommodation required. No extra charge is made for medicines or medical attendance (except in special cases).

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VISRANTHIPURAM TUBERCULOSIS SANATORIUM.

RAJAHMUNDRY, E. GODAVARI DT. (SOUTH INDIA).

FOUNDED in 1926 by the Christians of Rajahmundry and managed by a Board.

MAINTAINED by donations received from Christian Bodies, Municipalities, Local Boards, private charities and fees from patients. Government of Madras meet half of the net expenditure by annual grants subject to a maximum of Rs. 3,000.

ADMISSION—There is no restriction to admission whatsoever.

ACCOMMODATION AND CHARGES—30 beds open to both males and females.

General Wards—Charge is Rs. 15/- per mensem. This includes food and treatment.

Patients are required to take with them: Bedding, drinking cups, two blankets and three changes of usual clothing.

Special Wards—charges vary between Rs. 30/- and Rs. 60/- according to accommodation required.

TREATMENT consists of rest, graduated exercise, Tuberculin, Sanocrysin etc. and other surgical methods, such as Artificial Pneumothrorax and phrenicotomy.

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EDWARD VII TUBERCULOSIS INSTITUTE.

EGMORE.

ACCOMMODATION—The Hospital contains 80 beds. Patients of both sexes suffering from tuberculosis of the lungs are admitted.

CHARGES—Government servants are charged, per diem, at the rates given hereunder. Others are charged at double the rates. Persons whose income is less than Rs. 50/- p. m.—free; 50—100 p. m. -/4/-; 100—150 p. m. -/8/-; 150—200 p. m. /12/-; over Rs. 200/- p. m. 1/4 per diem.

TREATMENT—Artificial pneumothorax, phrenic evulsion, ultra violet light treatment etc. are adopted.

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PUNJAB

KING EDWARD SANATORIUM.

DHARAMPORE (SIMLA HILLS).

ESTABLISHED in 1909 by the Consumptives' Homes Society, Bombay, for the treatment of consumptives in the early stages of the disease.

ACCOMMODATION—Situated in a beautiful pine forest, over 5,000 feet above sea-level it has an area of 100 acres with accommodation for about 90 patients and is open all the year round and tends to the needs of Europeans and Indians of all classes.

CLIMATE—Average rain fall is 60 inches.

		Min.	Max.
Mean average temperatures	Summer	70	90
	Monsoon	65	80
	Winter	40	60

The Sanatorium has a very efficient supply of wholesome water of its own called "The Lady Hardinge Water Works", brought over from a distance of 8 miles and stored in a reservoir.

LOCATION—The Sanatorium is within ten minutes walk from Dharampore Railway Station on the Kalka Simla Section, N. W. Ry., and 20 miles by rail, and 16 miles by the motor road from Kalka Railway Station. Conveyances of all kinds are available at Dharampore Railway Station; patients must come up in *dandies* to the Sanatorium; the charge is about one rupee for a trip. Sanatorium authorities, if informed beforehand, will send the Sanatorium Car to meet the patient at Kalka Railway Station, in which case the patient may alight right inside the Sanatorium. A rate of Rs. 8 for the journey is fixed, and should be paid to the Motor Driver on arriving at the destination.

APPLICATION FOR ADMISSION—Admission is allowed only on application and medical certificate. The applicant should be in an early stage of the disease and in a fair general state of health. In pursuance of the Regulations introduced by His Highness the Maharajadhiraj of Patiala, consumptives are not allowed to occupy houses anywhere in Dharampore except either in the Sanatorium or in the Hardinge Hospital.

CHARGES—The accommodation charges include equipment of ward medical attendance, sanitary service and such ordinary medicines as are kept in the Sanatorium Dispensary. Patent medicines, costly injections, medical requisites—thermometers, inhalers etc.—will be charged for.

Only one servant or a bonafide attendant at the discretion of the Medical Superintendent is admissible under B. & C. accommodation.

Accommodation is also available for patients' friends, relatives and other paying guests in the "Nowsherwan Adul Guest Houses" subject to existing Rules for a period not exceeding seven days. A Sanitary charge of Re. 1 per day per room for one, or Rs. 1-4 per day for two visitors in a room, will be levied. Meals, part time attendance, light, hot water etc., will be provided on payment from the Sanatorium Mess.

Only a limited number of poor patients will be accommodated, treated and dieted free of charge on their satisfying the Superintendent of their eligibility for admission. Each applicant should send a certificate from a known gentleman of the place to which he belongs.

1. Nineteen class A cottages, each at Rs. 90/- per month available as follows:—

(*a*) two cottages for Convalescent patients,
(*b*) two ,, ,, Gujarati Hindus,
(*c*) four ,, ,, Parsees,
(*d*) four ,, ,, Female patients,
(*e*) seven ,, ,, All Communities.

2. Three class B cottages, each at Rs. 75/- per month.

3. Six class B rooms, each at Rs. 60/- per month.

4. Sixteen class C rooms, each at Rs. 45/- per month.

5. Fortythree class D rent-free beds, available as follows:—

(*a*) twentyone single rooms for all communities, male patients; (*b*) four single rooms for all communities, female patients; (*c*) six beds in a Pavilion Ward for Orthodox Hindus; (*d*) eight single rooms for Parsee male patients; (*e*) four single rooms for Parsee female patients.

6. Tent accommodation when available, at Rs. 45/- per month.

7. Attendants' rooms (unfurnished) when available, each at Rs. 10/- per month.

DIET CHARGES—

1. Vegetarian, Ordinary scale, Rs. 45/- per month.
2. ,, Special scale, Rs. 75/- per month.
3. Non-vegetarian, ordinary scale for Indians, Rs. 60/- per month.
4. Non-vegetarian, ordinary scale for Europeans and Parsees, Rs. 75/- per month.
5. Non-vegetarian, Special scale for all communities, Rs. 100/- & upwards.

Honey, fruit, soup etc., are included in special scale diets, but when prescribed for patients on ordinary scale diets extra charge according to fixed scale in the Sanatorium Mess will be levied.

MISCELLANEOUS—

No servant under 16 years of age will be permitted to work for any patient under any circumstances.

Part-time attendance by Sanatorium Servants at Rs. 5/- per month for each patient will be available, whenever necessary.

RAJPUTANA

MARY WILSON SANATORIUM.

TILAUNIA *via* KISHANGARH.

LOCATION—Mary Wilson Sanatorium is within a five minute walk of Tilaunia, a station on the B. B. & C. I. Ry. 25 miles east of Ajmer. The elevation is fully 1500 feet, the average rainfall being 20 inches.

MANAGEMENT—The Sanatorium is under the direction of missionaries of the Methodist Episcopal Church, and admits women and children of all races and religions suffering from any form of tuberculosis.

ACCOMMODATION—

1. Family Suites.—Consisting of an enclosed compound with open veranda protected with expanded metal, bath room, store room and kitchen. Two adults are allowed with each patient. No children allowed except with special permission. These suites are Rs. 40/- per month; Rs. 60/- if a second patient of the family occupies the suite. This covers rent and ordinary treatment.

2. Private rooms.—Room, bath, and veranda accommodation. Patient allowed choice of Indian or European food. These rooms are Rs. 15/- per month if with attendant; Rs. 10/- per month if no attendant.

Indian food for private room patient Rs. 10/- per month.

European food for private room patients Rs. 75/- per month.

This covers ½ seer milk daily.

N. B.—If special nursing is required in 1 or 2, an extra fee will be charged.

3. Wards which are open verandas—With special arrangements in case of Hindu or Moslem patients, one female attendant is allowed for the purpose of providing food but not to stay in the ward with patient. Bed in ward where attendant provides food, Rs. 10/- per month. Contributing missions for food, bed and treatment, Rs 6/- per month. Non-contributing missions for food, bed and treatment Rs. 15/- per month.

Water is laid on and electric lights are provided for all buildings in 2 and 3. All bulidings are of stone. 2 and 3 are strictly zenana.

A nursery is provided for children under six years of age who are not ill but must accompany mother, Rs. 6/- per month for each child.

Those making their own cooking arrangements must do so with the understanding that the Sanatorium will not handle supplies for them.

The nursing is done by Indian Nurses under the direction of an American nurse. An American woman physician is in charge.

ADMISSION—All applications should be addressed to the Medical Superintendent, Tilaunia *via* Kishangarh P. O., Rajputana. All business matters should be addressed to Business Manager.

UNITED PROVINCES.

THE ALMORA TUBERCULOSIS SANATORIUM.

LOCATION—The journey from Kathgodam to Almora is 80 miles by Motor bus or Car, and takes 8–10 hours in the former. At the Almora terminus dandies and coolies may be obtained to come the remaining 2½ miles to the Sanatorium.

ALTITUDE—The Sanatorium is surrounded by pine forests and is situated at an altitude of 5,600 feet above sea level. The patients live on wide verandahs in the open air day and night throughout the year.

ACCOMODATION—There are four blocks :

1. A General Ward accommodating about 25 Indian patients not attended by relatives. The inclusive fee for food and treatment is Rs. 22 a month. There are two private rooms for which an extra charge of Rs. 10 a month is made,

Concession rates of fees (Rs. 15 instead of Rs. 22 per mensem) are allowed to all Missions or other bodies contributing Rs. 200 annually to the Sanatorium Funds.

Those giving :—

Rs. 200 are entitled to send three concession patients at a time
Rs. 300 „ „ „ five „ „ „ „
Rs. 400 „ „ „ seven „ „ „ „

2. Private Wards—

Class A with accommodation for two patients. Here two relatives, male or female, may accompany the patient. The fee is Rs. 40 a month.

Class B with accommodation for three patients, each with a relative, male or female. The fee is Rs. 30 a month.

Class C for European and Anglo-Indian patients, with accommodation for 4 to 6 patients. The charge for one room is Rs. 30, or for two patients sharing a room, Rs. 15 a month each.

Private Ward patients are expected to make their own food arrangements, and a separate kitchen is allotted to each patient. Plates and drinking vessels are not provided in the general ward.

MEDICAL ATTENDANCE—A resident English woman doctor with Indian Nures under the superintendence of an English Nursing Sister.

ADMISSION—The Almora Sanatorium admits women and children of any race or creed. In making application the necessary forms must be filled in and signed. To avoid delay, all applications should be addressed to the Medical Superintendent, and not to the doctor by name.

KING EDWARD VII SANATORIUM.

BHOWALI.—DT. NAINI TAL.

ESTABLISHED in 1912 by the people of the United Provinces.

LOCATION—The Sanatorium is situated at a distance of 21 miles from Kathgodam on the Rohilkhand and Kumaun Railway (*via* Bareilly). A mail car runs daily between Kathgodam and Ranikhet *via* Bhowali and a seat in it may be reserved by writing in advance to the Naini Tal Motor Transport Co. Kathgodam. Motor conveyances are available at Kathgodam.

AREA—The area of sanatorium grounds is about 200 acres.

ALTITUDE—About 6000 ft. above sea level. TEMPERATURE—From April to Sept 76° F. with a min of 50° F. and a max. of 90° F. It is colder from October to March. Max. 60°, Avr. 47°, Min. 35° F. RAINFALL—Average 85 inches. principally in July, Aug., and Sept.

MANAGED by an Endowment Trust Committee.

MAINTAINED by Government grants, returns from endowments and fees realised from patients.

EQUIPMENTS.—There is an efficient and up to-date X-Ray apparatus with a suitable generating plant. The Dental Room has been well equipped for examination, extraction, scaling and filling up of teeth by a competent dentist.

RECREATION—Emperor's Birth-day and the foundation day of the Sanatorium are observed and a fete is held on each occasion. Minor social events such as tea parties, at homes, acrobatic and other shows are arranged for diversion to patients. Harcourt Butler Recreation Shed is equipped with an assortment of indoor games.

ADMISSION—The Sanatorium is kept open usually from the middle of March to the middle of December.

Patients may be of any race or sex.

Inhabitants of the United Province are given preference for admission.

CAUTION—The same patient is not admitted for more than two consecutive years.

STAY—The climate of Bhowali is usually at its best from the middle of September to the middle of December, and patients specially those who join the Sanatorium late in the season, are strongly advised to stay right till the closure of the Sanatorium for the winter recess.

ACCOMMODATION AND CHARGES—The Sanatorium has accommodation for about 100 patients.

Charges for Residents of U. P. are less than for the people of other Provinces.

Sanatorium fees include accommodation, conservancy, medical attendence, ordinary medicines and injections but NO BOARD, except in the "D" class patients.

Special section class 'A" for male or female patients—an entire two roomed cottage with privy, bath room and kitchen, Rs. 80/- per month for U. P. residents. Rs. 120/- for non-residents.

"B" for male and female patients—one room in a two-roomed block cottage with privy, bathroom and kitchen—Rs. 40/- for U. P. and Rs. 60/- for non U. P. men.

"C" for male patients—One room in a "block" with common privy and bath room and a kitchen shared between 2 patients Rs. 20/- and 30/- respectively.

"C" for female patients—One room in a block with privy, bath room and kitchen—free.

In class "A", two, and in "B" and "C', 1 male or female attendant for each patient is allowed.

In these classes, each room is furnished with bed-stead, bed side locker, a small table, two chairs and a lamp. Patients must bring their own lanterns.

"D" for male patients—One bed in an open air Ward with common privy and bath room—optional contribution. Non-residents of U. P. are not admitted. Food is supplied by the Sanatorium, no attendant is allowed. Patients must take with them their own bedding and eating utensils.

If "D" class patient is unable to contribute anything towards his upkeep, he must send with his application a certificate from a gazetted Govt. Officer or a respectable citizen from his own town to the effect that he is deserving of admission to the Sanatorium as an entirely free patient.

The approximate cost of living to a patient on full diet is Re. 1 per diem : all food stuffs are available for purchase on the Sanatorium premises and patients are required to buy their provisions, milk, meat and firewood from the Sanatorium purveyors.

Special Section—For persons living in European style. The charges are same for both residents and non-residents of U. P.

Cl. I—One room in a block or two-roomed cottage with bath room Rs. 150/- per month.

Cl. II—One bed in a room shared by two patients with bath room—Rs. 100/- per month.

Cl. III—One bed in a glazed verandah Re. 60/-. In all these classes food is supplied by the Sanatorium. No attendant is allowed. Crockery, cutlery and lights are provided. Patients must take with them their own bedding. Each has to employ a bearer who may accompany the patient or be engaged locally. A Matron is employed to look after the general comfort of the patients but no arrangement exists for patients who may be seriously ill.

GUESTS OR ATTENDANTS—Relations are permitted to stay with a patient to look after him and minister to his needs.

Tent accommodation at the rate of annas -/8/- per day is made available for patients' relations and friends who go to the Sanatorium on a visit to the patients for a period not exceeding one week.

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BHOWALI TUBERCULOSIS COLONY.

PUNDIT KULOMANI, a local Zemindar, and M. SHAULAT ULLAH, of Murshidabad have founded two colonies for tuberculous patients, but no details are available.

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[Details of some of the Sanatoria are not available. Ed.—J. I. M. A.]